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EUROPE & LATIN AMERICA

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FRG SPACE POLICY IN FINANCIAL DILEMMA

36980595 Bonn DIE WELT in German 10 Jul 87 p 11

[Article by Arnulf Gosch: "Space Dilemma"; first paragraph is DIE WELT introduction]

[Text] Hasty promises to participate in space projects have gotten Bonn into trouble with its partners abroad. Lack of money makes new solutions necessary.

What was heralded over a year ago, has now become all too obvious: The Federal Republic of Germany cannot meet expectations, fueled by the government itself, concerning participation in three major international space projects. Necessary funds are lacking. Bonn was ill-advised to get involved in this plan involving three unknowns: Ariane 5, Columbus, and Hermes.

Criticism is aimed not so much at Research Minister Heinz Riesenhuber as much as it is at the Chancellor and the Foreign Minister, who in early 1986 in the exuberance of European or, more correctly, Franco-German feelings, made promises to the Paris Government, which simply can not be financed. Moreover, there was already a Bonn cabinet decision of January 1985 which made it crystal clear that, under the present circumstances, the potential for other space projects of comparable size would be exhausted with Ariane 5 (a more powerful European rocket) and Columbus (a laboratory module for the permanently manned U.S. space station).

But the Chancellor put himself above this decree and made an offer to his colleague Mitterrand regarding a significant participation in the French spaceplane project, Hermes. The only thing left for the Research Minister, who based upon his position should be solely responsible for such matters, was the thankless job of agreeing with a forced smile, though with the proviso that the additional billions had to be covered by other budgets.

Finance Minister Stoltenberg had long balked at additional expenditures for space adventures of this sort. Though he first agreed to a compromise solution, it has now become clear to him that the ensuing costs, expected to run into the billions, will become too much for him.

Meanwhile, the European Space Agency (ESA) has calculated that the realization of all three projects, at 1986 prices, would eat up approximately ECU 33 billion, a good DM66 billion by the year 2000. Assuming an additional inflation rate of 2.5 percent, these costs would increase to at least DM100 billion, according to ESA. Since the Federal Republic of Germany wishes to have a 28 percent share in these projects, it would be obliged to provide the ESA DM28 billion, 20 billion more than expected. To date its yearly contribution has been 700 million.

Obviously, such amounts cannot come from the research budget. Even though Riesenhuber is behind a space commitment 100 percent, supporting of other fields such as basic research or earthbound advanced technologies is more important to him. This dilemma apparently having been made clear to all participants during a discussion with the Chancellor a week ago, the Research Minister now has to feverishly search for alternatives for German participation by the time the cabinet makes a final decision in late September.

The development of a more modest Columbus module is on the discussion table. Now they are saying that Columbus no longer needs to be so well-appointed that it can be docked as well as fly freely. They are also thinking about considerable cutbacks in France's pet project, Hermes, sending it into space unmanned with the already existing Ariane 4 launcher. For now, nothing has come of Ariane 5.

No matter how Bonn's little fairytale play turns out, there will be disappointment and anger: for example, in companies that have already gotten ready for fat ESA contracts and have done some preliminary work. There are calculations, according to which if this or that projects were canceled hundreds of highly qualified workers would be left jobless. But there will also be anger, on the part of the Americans and, above all, France. Surely it would have been better to refuse, from the start, to make promises concerning financially unpredictable projects of this magnitude. Is Bonn an unreliable reliable partner?

And the German taxpayer will not exactly judge this Bonn space hullaballoo to be an expression of farsightedness and rigorous economic and research policies either. Perhaps such breakdowns can be avoided in the future, if the German space effort were to be better organized. The beginnings of this, the creation of a space agency (DARA), organized under private law, are being examined at the moment.

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ESA NOVEMBER HAGUE CONFERENCE TO WEIGH SPACE PROJECTS, COSTS

36980592 Paris LE MONDE in French 15 Jul 87 p 10

[Article by Jean-Francois Augereau: "Space: Europe Takes Off: How the Ambitious Programs for the Next 13 Years will Be Financed"]

[Text] Who will pay and how? It will take the European ministers responsible for space issues a good four months to resolve the problem. Upon their choices depend the development of Europe in space and the position it will occupy in this field alongside the United States, the Soviet Union, and a few others such as China and Japan.

All these questions should be rigorously discussed on the 9th and 10th of November during the major conference at The Hague (Netherlands). For, as the General Director of the National Center of Space Studies, Mr Frederic d'Allest (Footnote 1)(LE MONDE of June 12. Mr d'Allest is also CEO of the Arianespace Company, which is in charge of the promotion and commercialization of the European launcher Ariane), recently remarked, Europe is going to have to "maintain its efforts during the next 15 years to reaffirm its position in fields where it is already successful," but also to conquer a new frontier, that of "the use of space by man."

The Europeans had proclaimed such an intent in Rome in January 1985. "They made decisions then without committing themselves financially," which one expert noted will not suffice at The Hague in November, "where it will be necessary to make a true commitment and put money on the table." On that day the ministers will have to say--and it is a true political choice--if they are ready to rise to this new challenge, or if they want, as Mr d'Allest put it, "to leave the United States and the Soviet Union the only participants in this new conquest."

This is the reason why the services of the European Space Agency (ESA) have prepared for this meeting by drawing up a plan on the long-term (1987-2000) activities of Europe in space, which the council of the Agency recently approved with a few minor variations. For the moment it is merely a matter of a working draft which the agency administration, its council, and the governments of the various countries concerned will consider during the course of the summer in order to attempt to reach a consensus before the meeting at The Hague.

It will hardly be an easy matter, for it is not enough to be convinced of the necessity for Europe to be a full, separate power in the field of space. It is also necessary to be up to the task of planning over time the programs and financing for all the activities approved. And on this matter those high financiers, the financial ministers of the countries concerned, occasionally display some reservations about committing themselves too quickly.

It is true that the cost of this long-term 13-year program has been estimated at 33.08 billion units of account [UC] (Fr226.6 billion); three times more than France has spent on space in 25 years! Those responsible in the government are also thinking twice when they notice that this will translate in the end into a significant increase in the ESA budget, which will rise from 1,500 million UC in 1987 to 2,600 million in 1993.

Cold Water

Under these conditions, is it any surprise that Great Britain, despite the relatively small sums it allocates to European space activities, is militating for a staggering of expenses? Is it any surprise that the FRG government, a large purveyor of funds for Europe in space, and pressed by its industry, is beset by internal dissent and is throwing cold water on the matter while waiting for negotiations?

And finally, how can France, who wields the largest space budget in Europe (over Fr5 billion), manage to bring it to Fr8.5 billion in 1990? It is up to the ministers to answer by scrutinizing this ambitious program. Of the 33 billion UC that it will cost if adopted, 12 billion concern the development of the three flagship programs of Europe:

--the heavy launcher Ariane-5 (3.5 billion UC between 1988 and 1996), capable of putting into orbit a payload of close to 7 tons at an altitude of 36,000 km, and whose first launch is set for 1995;

--the Colombus program (3.46 billion UC between 1988 and 1998), whose 4 components will be launched in 1994 for Eureka-B, 1996 for the APM element, which should correct the American manned space station, 1997 for the polar platform (a sort of specialized satellite), and 1998 for the man-tended autonomous module Pallas (MTFF), which could serve as a base for a future European space station;

--the space plane Hermes (4.43 billion UC between 1988 and 1999), with a first launch in 1998. It should be noted that the bill for this program has appreciably increased (Footnote 2)(In Rome, approximately 2 billion UC were estimated), proof if ever there was that manned flight is no light matter. To these figures must be added an additional 700 million UC for the development of the DRS relay satellites which permit the users of the preceding tools to receive directly the data gathered in orbit.

These different programs already enjoy subsidies under the heading of preparatory phases, and the Agency council has recently decided to grant extensions. Thus a total of 618 million UC have been allocated for Ariane-5, for Colombus 235 million, and for Hermes 104.6 million.

Unassessed Benefits

All this is expensive. Very expensive. Would it not be possible to save a little money by deferring the financing of activities devoted to manned flight, whose justification is, according to some, essentially political? Perhaps, but it is a strong bet, that one day these activities will be to our advantage, even if today, as one specialist puts it, "no one is in a position to evaluate their true benefits." Excepting, of course, what would be recovered from various technological breakthroughs for future fighter planes, or for civilian supersonics like the Super-Concorde (Aerospatiale's AGV project).

Thus it is a difficult decision for those responsible for Europe's space program, which at the same time must develop its scientific space programs (3 billion UC have been provided), for the observation of terrestrial resources and meteorology (3.3 billion UC), for telecommunications (2.9 billion), and for the production in orbit of new or purer materials in microgravity (1.5 billion).

To this must be added various other budgetary packages for the financing of the space center of Kouru in Guiana (900 million UC), the launching of the different elements of the long-term ESA program, as well as the use of the data that will be obtained (2.3 billion UC), the launching of studies for a permanent European space station (1.1 billion UC), and for preparatory programs for the development of means of space transport to succeed the Ariane-5 (1.1 billion UC).

Add to this the general budget for the European Space Agency (2.1 billion UC) and the ground infrastructures to manage it all, and you will have an idea of the financial headache awaiting the ministers at The Hague in November.

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HEAD OF ESA HERMES PROGRAM ON DESIGN, STRATEGY, FUTURE

36980609 Brussels KNACK in Dutch 15 Jul 87 pp 152, 154

[Interview with J. J. Capart, head of ESA's Hermes program, by Lode Willems: "Europe Wants to Enter Space Safely"; in Paris; date and occasion not given; first paragraph is KNACK introduction]

[Text] One ESA project on which everything else depends is the spacecraft Hermes, which will assure access to space for Europe. The project is headed by a Belgian.

There is no lack of Belgians in ESA. George Van Reeth, administrative director. Raymond Orye, head of the Ariane program. Both Flemish. And at the head of the Hermes section of ESA in Toulouse, Walloon J. J. Capart. He has been with the European Space Agency for more than 20 years and was closely involved with state-of-the-art technology when he was at ESA's ESTEC technology center in Noordwijk, where he also managed to pick up a good deal of Dutch.

We met with him not long ago in Paris, along with French ESA astronaut Jean-Loup Chretien, who very early on made suggestions about safety in the Hermes program. Suggestions that are taken very seriously here, particularly after America's Challenger disaster.

That ESA should be well populated with Belgians seems perfectly natural to J. J. Capart. "Belgium has always gone the European route. We never had an independent program. We always followed ESA. And Belgians have always supported Europe. Other countries thought they also needed to set up national programs--Britain, France, West Germany, the Netherlands, and so on. But Belgians are real Europeans."

He was still working at ESTEC when the Hermes project came up. "I was won over immediately. It involves real state-of-the-art technology. Then, too, I really like France, I really like to work with the French, they make great colleagues."

In Paris we took a look at a 1:1 scale model of Hermes. The cabin is 4 cubic meters in size, which is comfortable for three people. Behind the cabin is a tunnel that provides access for (fairly lean) astronauts to the hold, which is

18 cubic meters in size and subdivided into a materials section (scientific and technological apparatus for experiments on board) and an 8-cubic meter section that will provide extra living and working space for the crew once the craft is in orbit.

As you know, there is one essential difference between the American Shuttle design and Hermes. Of course, they are both spacecraft to carry people and goods into space. The big difference is not that Europe's Hermes is somewhat smaller than the American Shuttle. The real difference is in the safety precautions for the astronauts. The very first design planned for Hermes to be placed on the nose of the launcher--in this case the Ariane 5, which has yet to be built--rather than fastened up against the side of it, like the Shuttle, which in itself provides more escape possibilities in case of a problem. The latest version builds in still other means of rescue.

[Question] So the Challenger accident made the Europeans think twice too?

[Answer] "Yes, of course. We've looked into all the details of the accident very carefully and the Americans have told us what all they'll be changing. But with Hermes we have an advantage, the advantage that we're starting from scratch. It's much easier to include safety in the basic plan than to modify it later. That's why Hermes carries a cabin that can be ejected if there are problems during launch or if Hermes has to return over an area with no landing field, such as over the ocean. In that case we can shoot the cabin away from the craft and let it come down on parachutes. That demands an enormous effort in the design and we're still not entirely ready. You've seen the life-sized scale model here, but between this model and the final version there'll be another seven Hermeses or so. Sort of rough drafts, each one better than the previous one."

[Question] We may be behind but that has the advantage that we can learn from the Americans' and Soviets' experience.

[Answer] "Yes, but I don't agree that we're behind. Our resources are 10 times smaller than the Soviets' and the Americans' so we've concentrated on achieving commercial independence--including television, telecommunications, and meteorology--and we've succeeded in that. We're competitive there. We've built the Ariane launcher, and it's a good one. And now we've decided to take our proper place in manned space flight. We've got a lot to do yet. But we're not behind."

[Question] How much progress has been made with the plan to make Hermes compatible with the two different systems, the U.S. and the Soviet, so it can link up with them?

[Answer] "The Hermes model you see here has a coupling compatible with the American standard. We're holding negotiations--still very tentative--with the Soviets to develop a compatible system. It could well turn out that Hermes is the first space craft that can be linked to both systems. But I don't feel that is the most important thing. The important thing is that Hermes is part of a totality of European projects that will make us independent in manned space flight. Hermes was not designed to pay little visits to other

countries. That's nice, but it's secondary. We're talking about Europe's own orbital infrastructure. About being able to launch scientific experiments without being dependent on somebody else's good will. We have to put people into space ourselves and have them be able to work there. And when I talk about working in space, that includes a lot of things. The astronauts have to be able to leave their craft, do certain things; there's a whole scenario involved."

[Question] But with Columbus--all the projects involved with the NASA space station--aren't we a little bit dependent on the United States?

[Answer] "At first the plan was that it would co-orbit with the American station and be supplied by the American station. But in the medium and long term we want to service the station ourselves. For now, we're on very good relations with NASA and will be carrying out operations with them for quite some time."

[Question] It all sounds very nice but recently when I heard ESA Director General Reimar Luest talking about having to double the budget this year yet, then I look around in Europe and see all the miserly little countries with their own little flag and their own little program.

[Answer] "In this period of crisis it's a fact that every country has to cut back and of course there are social priorities and priorities involving technology on Earth. It is indeed difficult to ask for a major increase in the budget as we are now.

"On the other hand, ESA has clearly proven that the money spent on it has not been wasted. We've got to set a goal and then be realistic and realize that it's impossible to accomplish it on a derisory fraction of what the Americans and Soviets spend on space flight. We believe that the European countries will understand and accept our point of view. And I particularly feel that about Belgium, which has always supported our projects. You know that Belgian industry is very interested in Hermes and has been smart enough to do good work for it. The will is there. Yes, more money needs to be spent on it and there will also have to be more spending in other areas too.

"ESA has also accomplished things in European unification. Thirteen countries are already participating in the Hermes project. Engineers from all those countries are working together in a genuinely European spirit, not a smidgeon of nationalism among us. I feel this is one way to show that Europe will really find itself around the end of the century. I'm convinced of that, because a Belgian sees it happening, he's got Berlaimont right at his door."

Caption of picture on p 152: Hermes linked to Europe's orbiting MTFF (Man-Tended Free Flyer) module. Hermes's 4-cubic meter cabin provides room for three astronauts. The hold is 18 cubic meters in size and is subdivided into a materials section and an 8-cubic meter living and working area for the crew.

Caption of picture on p 154: Besides taking the shuttle to the MTFF module, Hermes will also visit other space stations, primarily NASA's International Space Station but also the Soviet Mir.
12593

MATRA ESPACE TO PRODUCE DHS FOR ESA'S EURECA PLATFORM

Toulouse LA LETTRE DU CNES in French 1 Jun 87 p 10

[Article: "Matra Espace: a Self-Contained Intelligent System for Eureca"]

[Text] After having completed the equipment bay of the Ariane European launch rocket as well as the CDMS (command and data management system) of the Spacelab laboratory, Matra Espace was again selected to design the centerpiece of a major ESA program: EURECA [European Retrievable Carrier] with the DHS (data handling system).

Like the CDMS, DHS is a real electronic brain which processes and manages all the data required by the subsystems and experiments to assure the success of the missions. DHS, a very sophisticated system built around Matra-designed Protee and Puma computers, also handles large-volume transmissions to earth. Except for the few minutes of visibility with the ground stations every day, data will be stored in a SAGEM [Company for General Electricity and Mechanics Applications] mass bubble memory (128 Mbits); the other Matra contractors on this program are Compagnie Industrielle Radioelectrique (Switzerland) and Laben (Italy) for test equipment. Compared to the Spacelab CDMS, the essential difference and additional difficulty is that DHS is an intelligent automated system capable of detecting its own breakdowns and doing its own reconfiguration up to the highest decision level without any human intervention.

EURECA is a European platform weighing 3.5 metric tons at launch with a payload of 1 metric ton, which is placed into orbit for periods of 6 to 9 months before being brought back to earth by the space shuttle for reuse. This contract of over Fr 130 million (delivery of flight models in early 1988) is the most important contract concluded with the German company MBB/ERNO [Messerschmitt-Boelkow-Blohm/Northern Development Area] (chief contractor) in connection with the EURECA project. More than 100 contracts have been concluded so far between Matra and the German firm in 20 years of beneficial cooperation.

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CSO: 3698/A297

TECHNICAL SPECIFICATIONS OF ARIANE V HM60 VULCAIN ENGINE

Paris L'AERONAUTIQUE ET L'ASTRONAUTIQUE in French No 2-3, 1987 pp 113-121

[Article by J. Borromee, head of the Cryogenic Stage Division at CNES-Evry, and S. Eury, Vulcain Engine fabrication manager at SEP-Vernon, presented to the Propulsion Colloquium organized by AAAF on 5 December 1986 in Bordeaux]

[Text] Introduction

Ariane V's propulsion has raised a delicate optimization problem.

A composite system was selected, consisting of the following:

A hydrogen- and oxygen-powered central stage propelled by the HM60-Vulcain engine;

Two lateral solid-fuel boosters.

This approach was best among the other ideas being considered, due to its greater reliability resulting from its simplicity.

After start-up, engine operation is checked before clearing the firing of the solid-fuel boosters and takeoff. During the first phase of flight, the two propulsion modes operate in parallel.

The solid-fuel boosters separate after two minutes of flight, with the HM60-Vulcain engine supplying the only thrust. A shut-down command is issued when speed reaches the value for the selected orbit. During its 570 seconds of operation, the engine consumes about 22 tons of hydrogen and 116 tons of oxygen, and supplies the greater portion of the launcher's kinetic energy.

Design Specifications

A number of parametric studies and iterations have been carried out on the engine's specifications, aimed at establishing the most economic conditions for Ariane V's operations.

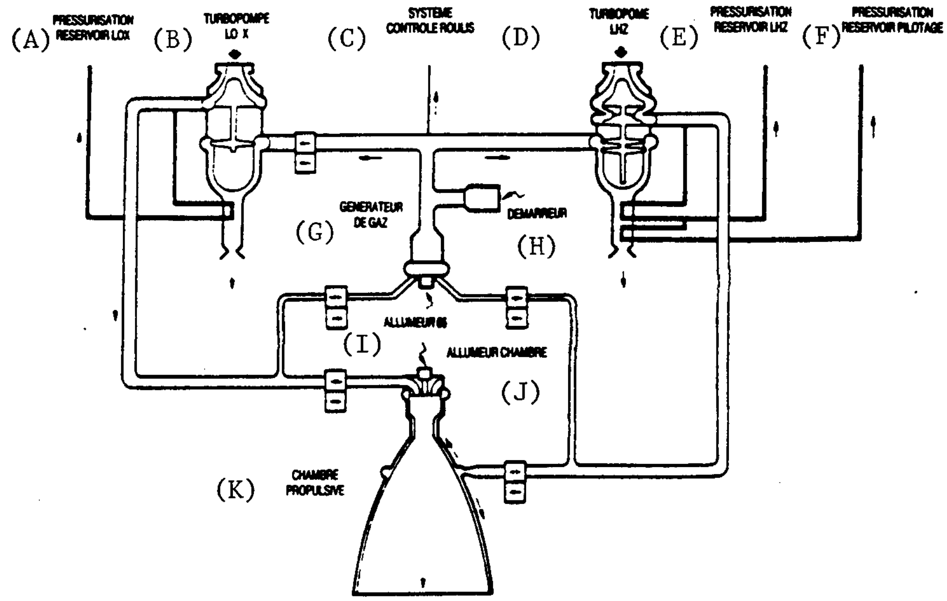

Figure 2. Hydraulic diagram of the Vulcain engine.

Key:
- (A) LOX tank pressurization
- (B) LOX turbopump
- (C) Roll control system
- (D) LH2 turbopump
- (E) LH2 tank pressurization
- (F) Control tank pressurization
- (G) Gas generator
- (H) Starter
- (I) Gas generator igniter
- (J) Chamber igniter
- (K) Thrust chamber

The resulting major performance requirements are:

Thrust in vacuum	1050 ± 50 KN
Mixture ratio in flight	5.1 ± 0.2
Specific impulse in vacuum	> 430 s
Net intake pressure, oxygen	< 1.5 b
hydrogen	< 0.4 b
Weight	1200 kg

These characteristics are essentially equivalent to those of Saturn V's J2 engine. The required performance level has been deliberately limited by CNES to no more than Ariane V's needs so as to reduce risks and development costs. This level, far less ambitious than that of the American Space Shuttle, does not force an a priori design option, but does leave a large field for optimization and the discovery of reliable solutions for minimum cost.

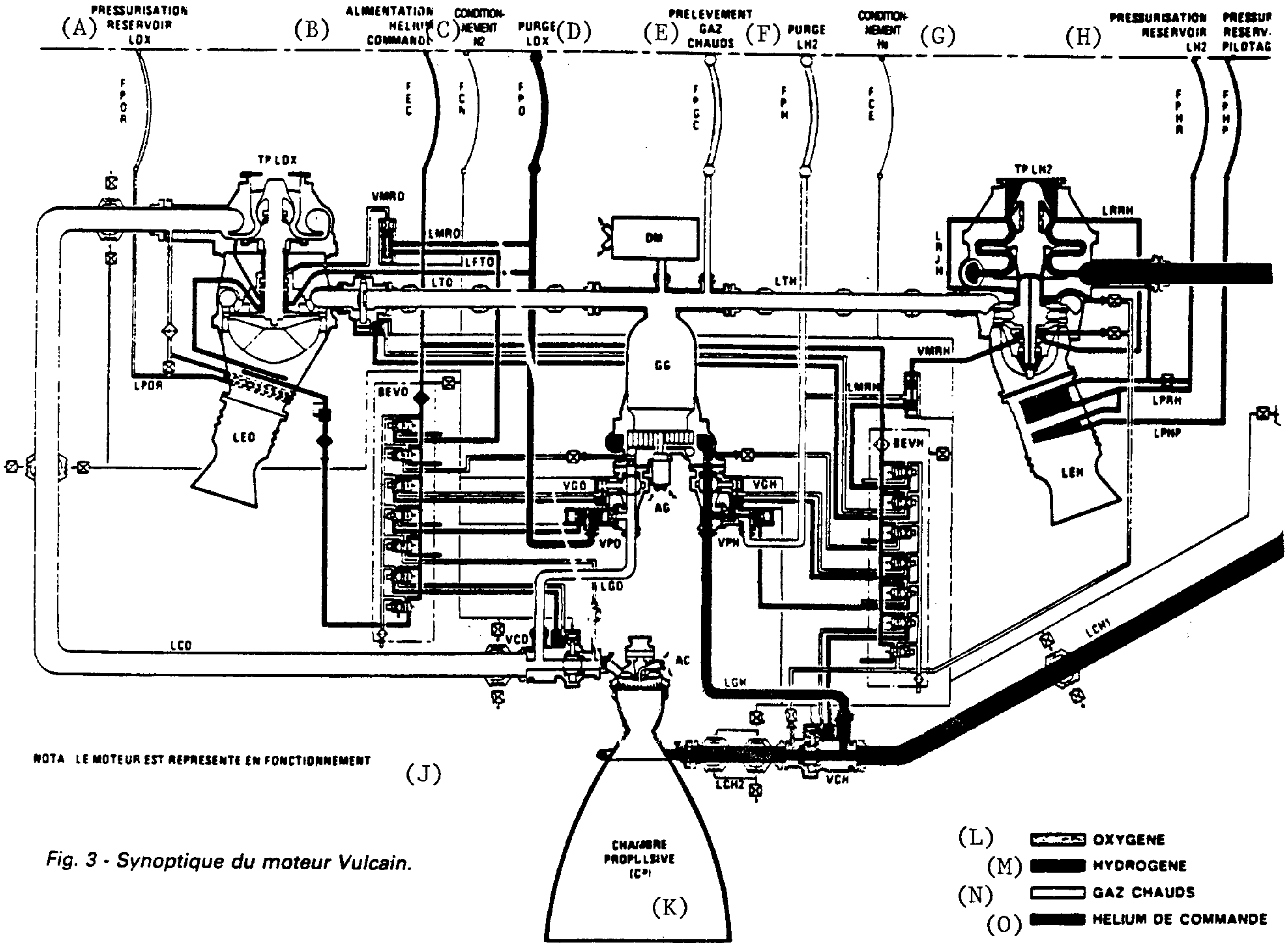

Fig. 3 - Synoptique du moteur Vulcain.

Figure 3. Vulcain engine schematic.

Key:
- (A) LOX tank pressurization
- (B) Helium control supply
- (C) N2 processing
- (D) LOX purge
- (E) Hot gas sampling
- (F) LH2 purge
- (G) He processing
- (H) LH2 tank pressurization
- (I) Control tank pressurization
- (J) Note: the engine is shown in operation
- (K) Thrust chamber
- (L) Oxygen
- (M) Hydrogen
- (N) Hot gases
- (O) Control helium

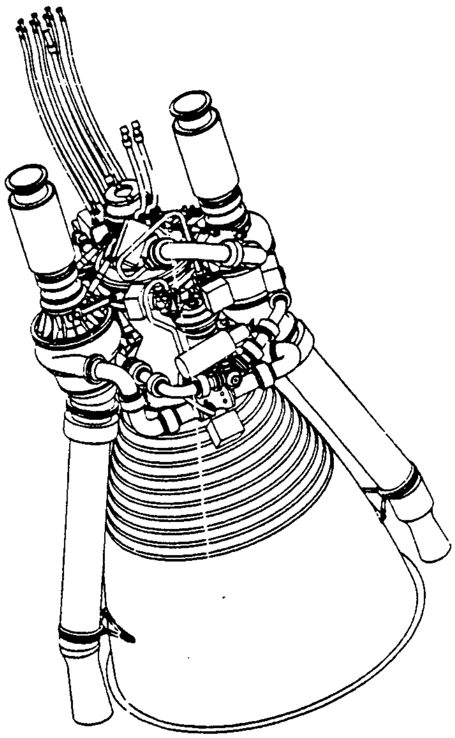

Figure 4. Isometric view of the Vulcain engine.

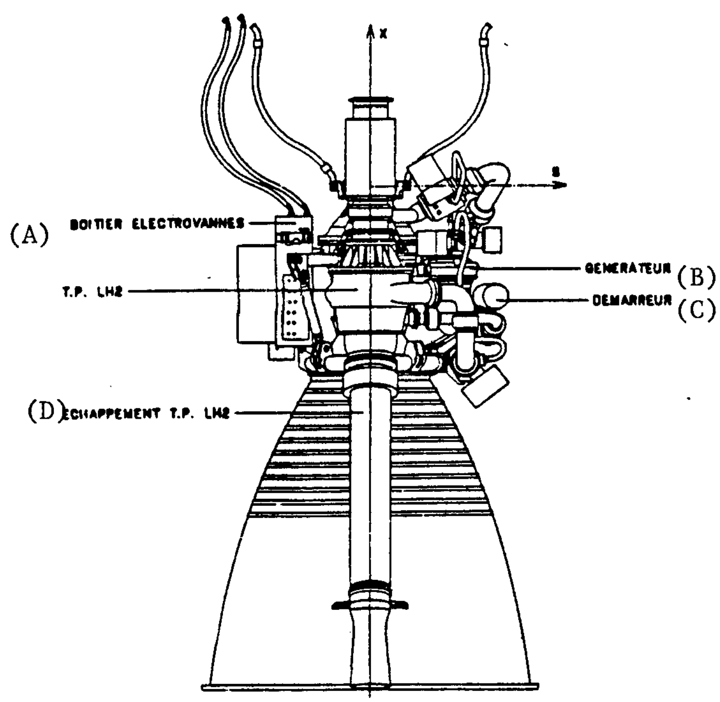

Figure 5. Side view of the Vulcain engine.

Key: (A) Solenoid valve enclosure
(B) Generator
(C) Starter
(D) LH2 turbopump exhaust

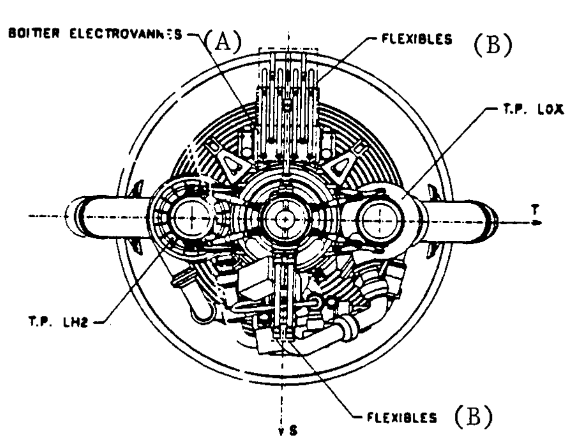

Figure 6. Top view of Vulcain engine.

Key: (A) Solenoid valve enclosure
(B) Flexible lines

Indeed, equally as much as performance, the essential requirements that must guide research, concern reliability, production, and operations. They are the real challenge that is facing our manufacturers.

The objective of a reliability greater than 0.99 derives from the context of the commercial competition expected for the next decade, as well as from the considerable financial gamble associated with a launch.

Quasi absolute reliability is necessary not only for the Hermes manned flights, but also to reduce the program's risks.

This exacting objective imposes rigorous steps which can be summarized as follows:

Identify major risks as early as the project's design phase, based on past experience and using functional analysis methods and zone studies;

Reduce the critical effects of failure modes which cannot be completely eliminated;

Detect and diagnose anomalies with instrumentation incorporated during the design phase, which should assure both safety and efficient maintenance.

The approach thus consists in preventing risks beginning with the preliminary definition phase, in order to introduce corrective actions at the earliest possibility for eliminating them or reducing their effects.

The other major design requirements concern manufacturing and operating costs.

Target-cost design must be the rule for all equipment.

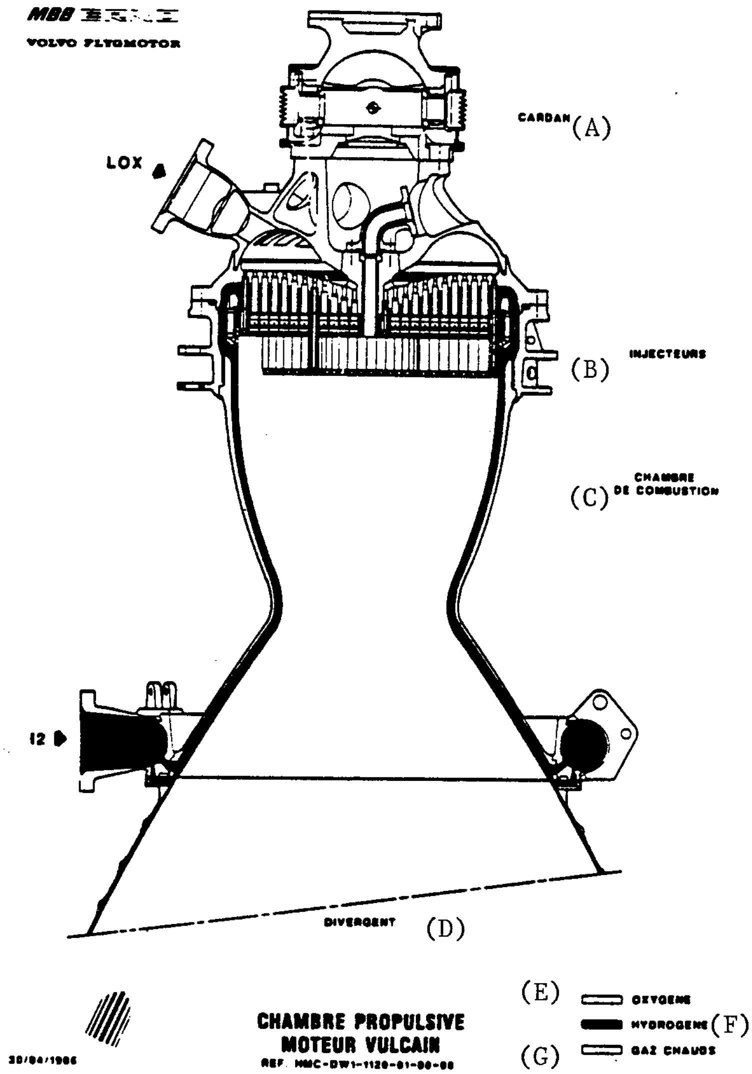

Figure 8. Thrust chamber diagram.

Key: (A) Gimbal
(B) Injector
(C) Combustion chamber
(D) Nozzle
(E) Oxygen
(F) Hydrogen
(G) Hot gases

Moreover, concern for production so as to extend performance reproducibility beyond prototypes is primordial, and will have to be the major criterion in selecting manufacturing and control procedures.

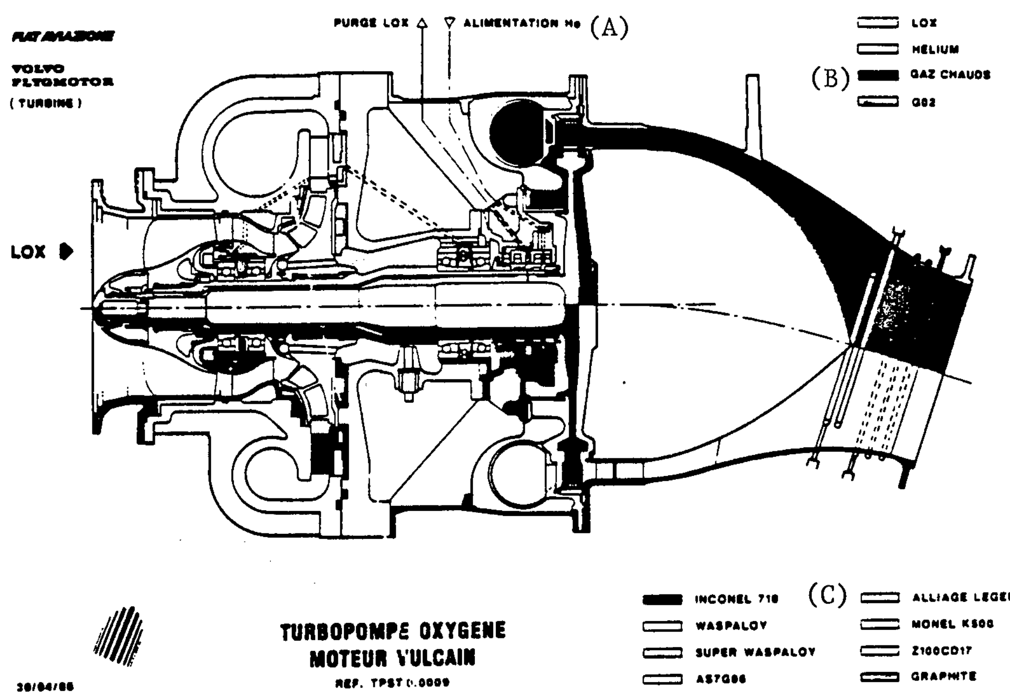

Figure 9. LOX turbopump diagram.

Key: (A) He supply
(B) Hot gases
(C) Light alloy

Particular attention will also have to be devoted to integration and intervention delays, which will have to be minimized through good accessibility for instance.

Similarly, the simplification of fabrication operations will have to be considered starting with the design phase for maximum reduction of operational constraints at the launching pad.

These objectives are essential for the success of the program, and require a shift in the viewpoint of engineers, who are more interested in performance.

General design recommendations have also been dictated by past experience so as to minimize risks and costs.

The conventional curve, which shows that the majority of a program's costs and risks are generated during the definition phase, must constantly be kept in mind.

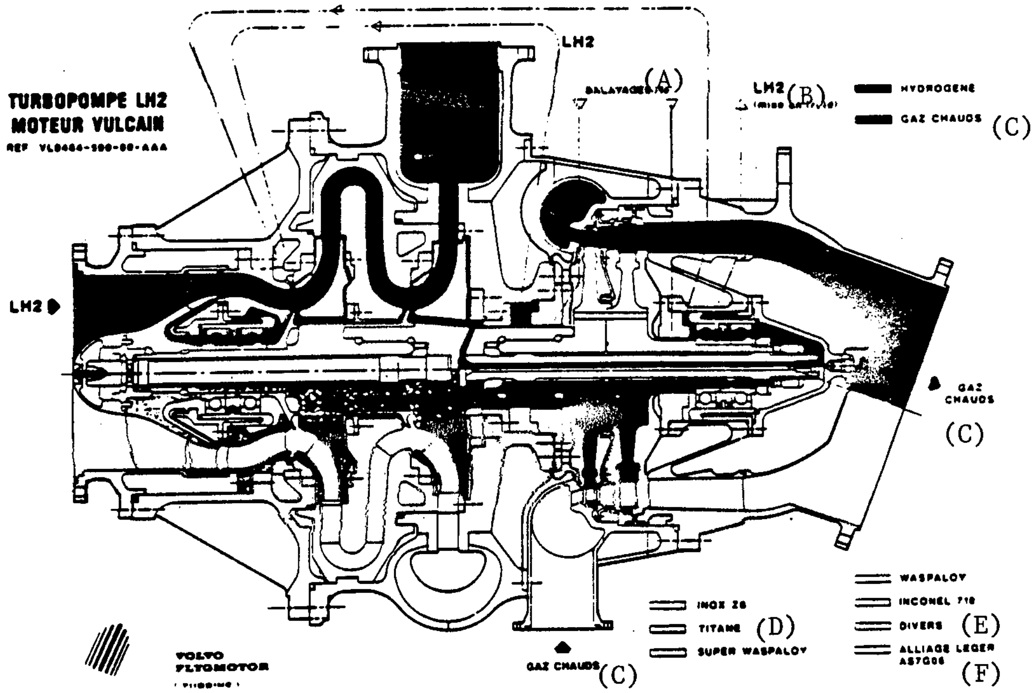

Figure 10. LH2 turbopump diagram.

Key: (A) Sweep
(B) LH2 cooldown
(C) Hot gases
(D) Titanium
(E) Various
(F) AS7G06 light alloy

The major directives cover:

Utilization of value analysis methods that have been tested on many programs;

Systematic mathematical modelling of events, with progressive corrections based on test results.

A significant effort has already been made and will be continued throughout the program.

Engine Description

The definition of the engine presented for Preliminary Definition Review is the result of comparative studies conducted since 1980 to optimize its performance, reliability, as well as its production and development costs. The Vulcain engine, whose prime contractor is SEP, is a shunted flow rocket engine whose block diagram is shown in figure 2.

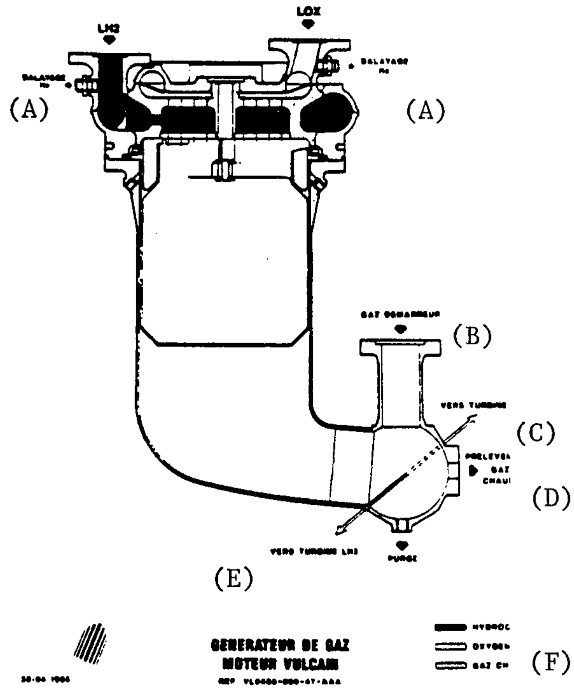

Figure 11. Gas generator diagram.

Key: (A) Sweep
(B) Starter gas
(C) To turbine
(D) Hot gas sampling
(E) To LH2 turbine
(F) Hot gases

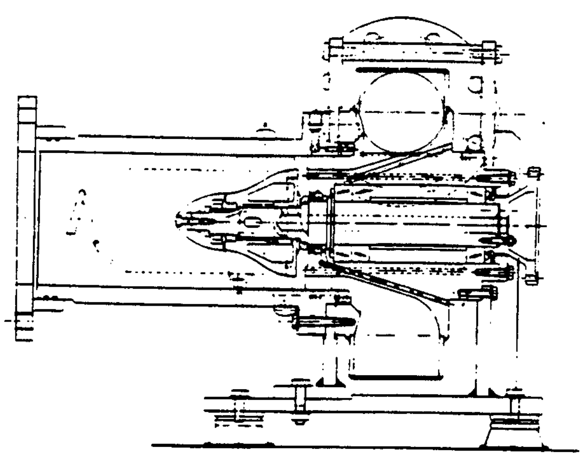

Figure 12. Water inlet test installation.

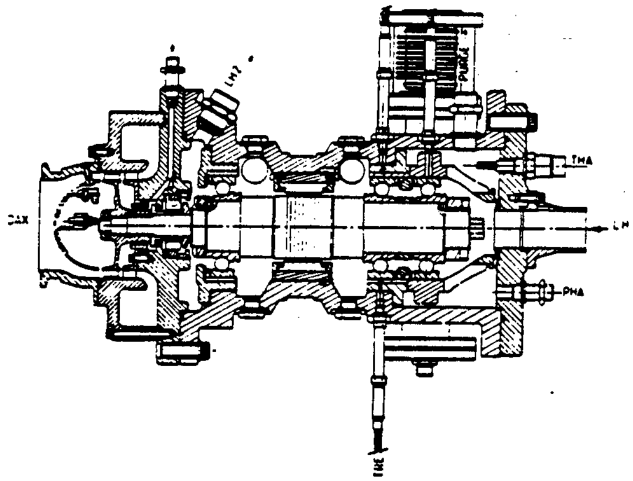

Figure 13. Bearing test installation.

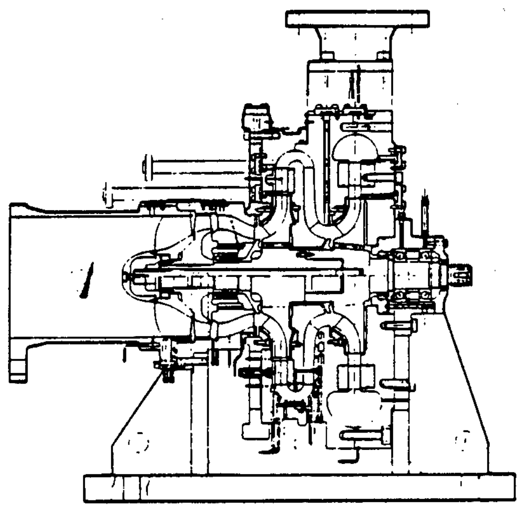

Figure 14. Air pump test installation.

It consists of a combustion chamber which creates the essential portion of thrust from high pressure fuel combustion followed by expansion of gases in a nozzle. The chamber wall is regeneratively cooled by circulation of the liquid hydrogen it consumes. The nozzle, which consists of welded tubes, is cooled by circulating a portion of the hydrogen that is exhausted at the end of each tube to produce additional thrust.

The liquid oxygen and hydrogen are stored in tanks, pressurized, and fed to the combustion chamber by turbopumps. The power required for each turbopump is supplied by a turbine which recovers a portion of the energy of hot gases produced in a gas generator by the combustion of a weak mixture of liquid hydrogen and oxygen.

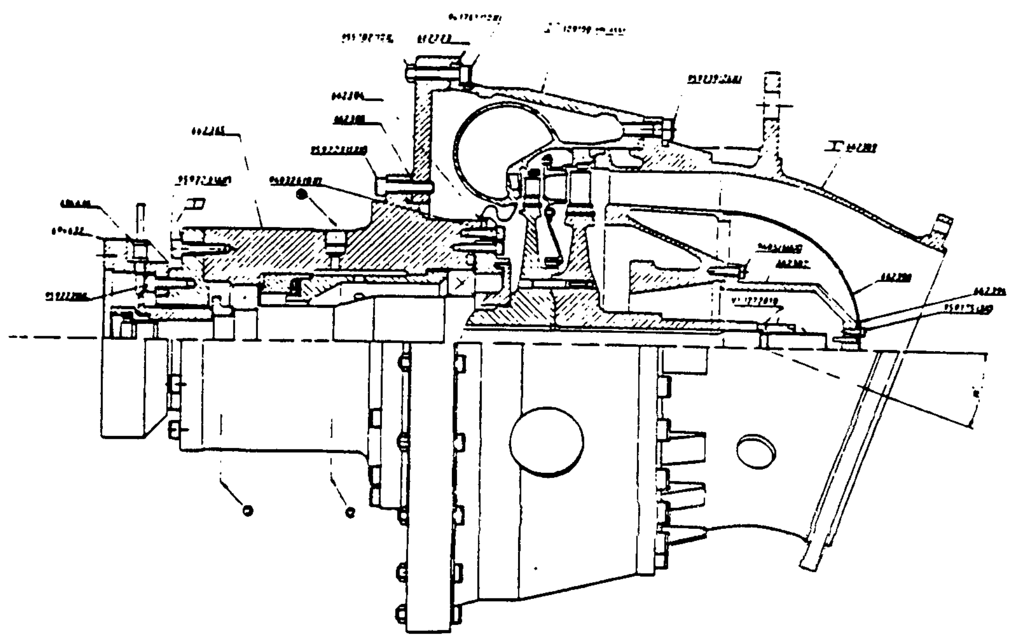

Figure 15. Turbine acceptance test installation.

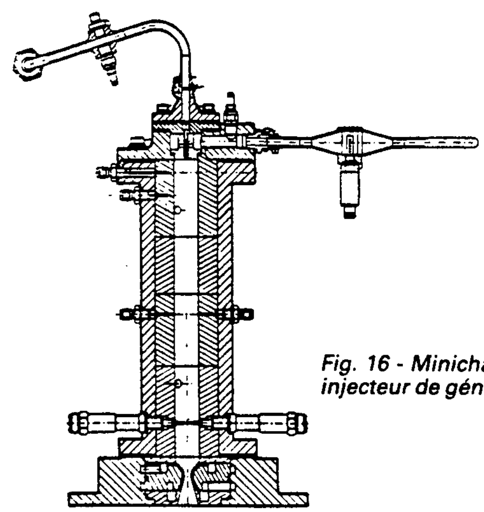

Fig. 16 - Minichambre avec un injecteur de générateur de gaz.

Figure 16. Minichamber with gas generator injector.

The engine has a single gas generator which supplies the two turbines in parallel. After expansion, the gases are discharged separately and supply additional thrust.

The implementation of a cryogenic engine requires the following precautions and preparations:

Pipe flushing with dry nitrogen to eliminate air and water vapor;

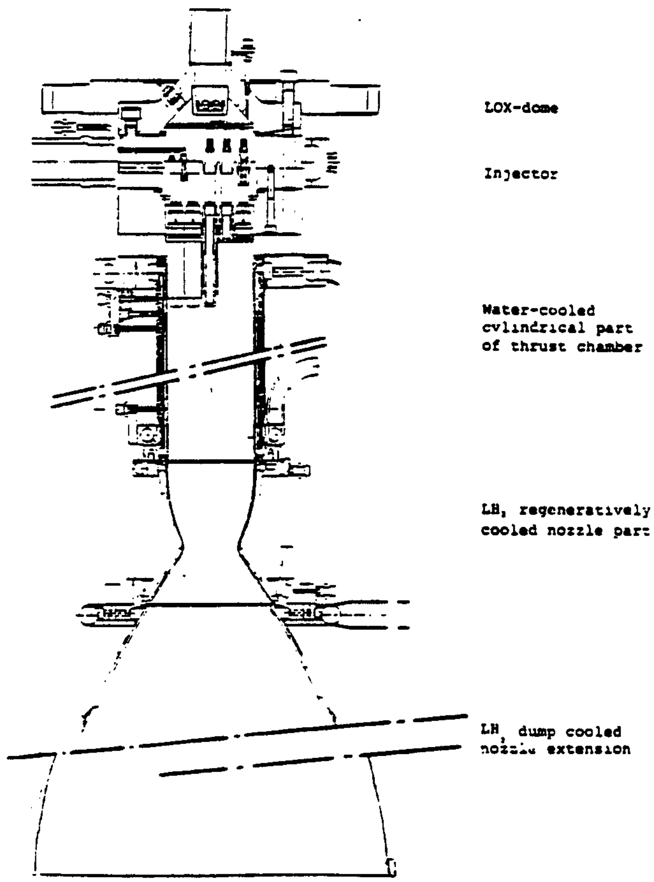

Figure 17. Thrust minichamber with 19 injection units.

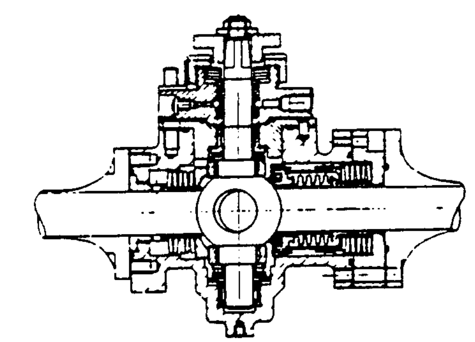

Figure 18. Battleship generator injection valve.

Additional LH2 pipe flushing with helium or hydrogen gas to eliminate nitrogen;

Pumps and engine pipe cooling to cryogenic fuel temperatures by internal fuel circulation in order to avoid pump cavitation at startup;

Engine starting with the following successive operations:

Cool down combustion chamber;
Start turbines with a pyrotechnic starter;
Ignite chambers with pyrotechnic ignition;
Ignite gas generator with pyrotechnic ignition;
Spin-up;
Check proper operation before launcher takeoff.

Cooling down takes several minutes and startup about three seconds.

Speed changes in flight are achieved by limiting the gas supply of the LOX turbopump turbine with a hot-gas valve.

Necessary airtightness during cooling, and precise and rapid control of starting and stopping sequences require rapid, precise, and reliable equipment (valves, shutters, solenoid valves, and so on).

The engine assembly and its accessories are shown in figure 3.

The engine also contains pyrotechnic devices and solenoid valves, as well as measurement sensors which provide information about its operating conditions and allow the initiation of safety measures in case of incidents or danger.

The engine, whose hot and cold parts must be able to expand and contract, is assembled around the thrust chamber, which serves as structure to support all the other subsystems or equipment. This assembly is shown in figures 4, 5, and 6.

Thrust Chamber

The thrust chamber shown in figure 8 is developed by MBB in FRG, and includes:

A titanium gimbal to allow pitch rotation and yaw steering;

An Inconel 718 injection head with an injector composed of 516 coaxial injection units;

A chamber body internally lined with a copper alloy with milled cooling channels, and with an outside cladding of nickel;

Fluid and mechanical interfaces with the rest of the engine.

The chamber is extended by a nozzle developed by Volvo in Sweden, which consists of square Inconel 600 tubes, spiral-wrapped and automatically welded (1.8 km of weld).

The technology used for the chamber and nozzle is derived from the one used on the HM7 engine.

The chamber allows the insertion of acoustic baffles and cavities to limit the risk of combustion instability.

The major specifications of the chamber are summarized below:

Weight	450 kg
Combustion pressure	100 b
Combustion mixture ratio	5.9
LH2 flow	36 kg/s
LOX flow	200 kg/s
Specific impulsion in vacuum	439 s
Cross section ratio	45
Total length	3000 mm
Diameter	1850 mm

Oxygen Turbopump

The oxygen turbopump shown in figure 9 is developed by Fiat in Italy. It contains:

A Monel K500 inlet;

A centrifugal pump stage with cast AS7 GO,6 flanges;

A pump body with a throat lined with AS7 GO,6;

A highly supersonic single-stage turbine whose disk is of Inconel 718; the attached vanes and the body are developed by Volvo and are made of Waspaloy;

Two bearings with LOX-cooled dual tapered rollers;

An absolute airtight device between the pump (LOX) and the turbine (GH2), using a helium buffer and dynamic floating-ring seal.

The rotation speed is lower than the first critical speed and shaft axial balance is obtained with a hydraulic piston behind the pump impeller.

The major specifications of the LOX pump are summarized below:

Rotation speed	13,000 rpm
Shaft power	3 MW
Pump output pressure	130 b
LOX flow rate	200 kg/s
NPSP*	1.5 b
Turbine gas pressure	60 b
Turbine gas temperature	900 K
Turbine expansion ratio	15
Turbopump efficiency	21 %
Weight	115 kg

Hydrogen Turbopump

The hydrogen turbopump shown in figure 10 is developed by SEP. It includes:

A titanium inlet;

Two centrifugal pump impellers with integral machined titanium flanges;

The two tandem pump impellers are separated by a balancing diffuser made of AS7 GO,6 light alloy;

The pump body is of Inconel 718; its forward portion is cast, and its central section is forged-machined-welded;

A two-stage supersonic turbine developed by Volvo; the disks are of super Waspaloy, the blades are flange-mounted, and the bodies are of Waspaloy;

A cast Inconel 718 turbine bearing support manufactured by Hispano Suiza;

Two LH2-cooled bearings with double tapered rollers;

A floating-ring seal between the LH2 sections and the turbine, developed by Hispano Suiza.

The speed of rotation falls between the second and third critical speeds.

The axial balance of the shaft is obtained with a hydraulic piston behind the second pump impeller.

The major specifications of the LH2 turbopump are given below:

Rotation speed	34,000 rpm
Shaft power	11 MW
Pump output pressure	160 b
LH2 flow rate	40 kg/s
NPSP*	0.4 b
Turbine gas pressure	75 b
Turbine gas temperature	900 K
Turbine expansion ratio	20
Turbopump efficiency	45 %
Weight	220 kg

Gas Generator

The gas generator shown in figure 11 is developed by SEP. It consists of:

An Inconel 718 injection head composed of 60 coaxial-brazed individual injectors;

A hydroformed and welded Waspaloy uncooled chamber with a forged and machined Waspaloy manifold;

An internal Waspaloy lining with acoustic cavities and baffles to limit combustion instability risks.

The major specifications of the gas generator are summarized below:

Combustion pressure	80 b
Maximum gas temperature	1040 K
Nominal mixture ratio	0.9
Gas flow	8 kg/s
Weight	40 kg

Stage of Development

The first models of these systems are being built.

The following installations are also being built to test them:

A test stand for the gas generator and LOX turbopump (P5.9) at MBB in Munich;

A test stand for the gas generator and LH2 turbopump (PF 52) at SEP in Vernon;

A thrust-chamber test stand (P3.2) at DFVLR in Lampoldhausen in FRG.

The first tests of these subsystems should take place in 1987.

Water tests of a LOX turbopump have been carried out at CETIM in Nantes to measure the cavitation characteristics of an inlet, and the corresponding stress in the blades. The installation for this type of test is shown in figure 12.

Dynamic seal tests of floating rings have been performed with gas and water, and the first cryogenic fluid tests should take place at SEP and Fiat at the beginning of 1987.

Short tests of LH2-cooled bearings have been carried out by SEP in Villaroche; longer tests should begin in Vernon early in 1987 on a new test stand with an installation shown in figure 13.

Tests of LOX-cooled bearings should begin early in 1987 at Fiat.

Pump tests with air and then with water in 1987 will verify the hydraulic performance of the turbopumps.

Aerodynamic tests of the turbines have been conducted with hot air at Volvo to check the aerodynamic behavior of the turbines and their performance.

Acceptance tests of the first turbines will be carried out on an installation shown in figure 15.

Tests of individual injectors for the gas generator have been carried out in Vernon on a special test stand with a single-injector minichamber. These tests verified the characteristics of this device.

Tests conducted by MBB in Munich with a small-scale chamber similar to the engine's thrust chamber, but containing only 19 injection units, provided information about the chamber's injection units, making it possible to optimize them and to confirm the mechanical behavior of the technologies that will be used.

Gas and water tests of a "battleship" generator injection-valve shown in figure 18, has validated the design (removable valve core) and provided information about the characteristics of such a valve.

All these component tests will make it possible to undertake major subsystem tests with a certain degree of confidence and safety in 1987.

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BRIEFS

NEW A-330/340 MANUFACTURING PLANT--Launching of the A-330/340 compels Aerospatiale to invest in a new installation. This factory, which became necessary because of the dimensions of the aircraft, will be built near Toulouse, at Saint-Martin-du-Touch. Construction of the assembly hall and the manufacturing and painting rooms is estimated at Fr 1.5 billion. Capable of finishing four to five aircraft per month, the installation will be ready by 1989. [Text] [Paris L'USINE NOUVELLE in French 11 Jun 87 p 37] 25063

CSO: 3698/A264

FRG DAIMLER-BENZ: DM 24 BILLION INVESTMENT FOR 5 YEARS

Duesseldorf HANDELSBLATT in German 21 May 87 p 17

[Article by "gh": "Path to New Age in Automobiles Via Ulm, Rastatt"]

[Text] Stuttgart--"In 1986, demand for Mercedes automobiles continued high both inside Germany and abroad, once again in excess of our production capabilities...In contrast to other car manufacturers, Daimler-Benz was able to continue increasing its passenger car export business."

It would be very easy to overlook these two sentences in Daimler-Benz' annual report which reflect the tremendous expansion the firm has experienced since its acquisition of AEG. But the fact is that the constantly rising demand on the world market throughout 1986 for the specific high quality of Mercedes passenger automobiles once again was the focus of company's operations, the core of all other activities and the guarantee of success.

In 1986, Daimler-Benz "once more made satisfactory" profits, above all due to successes in the passenger car field. "In this field, we were able to offset the rise in the value of the DM vis-a-vis the U.S. Dollar by means of a sharp rise in sales, higher-quality production and pricing adjustments," the report states.

These successes are the result of Daimler-Benz' innovative potential which had already been impressive prior to the merger with AEG, Dornier and MTU. During the course of 1986, the company spent DM 1.9 billion (i.e. DM 200 million more than in 1985) on further development and improvement of its passenger car and commercial vehicle programs and had 11,000 people working in its construction, testing and research departments.

Domestic registration of Mercedes passenger automobiles increased by 10.9 percent to a total of almost 295,000 and exports increased by 6.5 percent to more than 296,000 vehicles. "In spite of market and currency problems, we made significant gains in most West European countries as well as in the United States and Japan," the report states proudly. In spite of the well-known difficulties in the heavy vehicle market which have not spared Daimler-Benz, the company's sales in this sector rose by almost 10 percent to more than DM 40 billion while the number of jobs took another jump of 5,000 to more than 166,000.

Prof Dr Werner Breitschwerdt, the Daimler-Benz chairman of the board, believes that the competitiveness of the German auto industry is dependent on the extent to which it succeeds in applying new technologies in its products and production processes. "Particularly in the field of high-quality and high-tech vehicles," the report goes on to say, "the best prospects for the future lie in the skillful combination of traditional and advanced technologies."

Use of Electronics Growing Fast

This applies to the entire field of electronics, to new materials and to sensor technology. Traditional product thinking must give way to system thinking so that the growing demand for safety, user economy and enviromental compatibility can be met. The share of electronics in the value of the individual automobile will increase from 0.5 percent today to more than 10 percent over the next 15 years, the report predicts.

"We are not planning to build any subcompacts," the report states, pointing out that the company is concentrating its efforts on the "sophisticated technology car market." And in this field Daimler-Benz will once again be aiming for even higher quality. This is true as well of the commercial vehicles division. In this field, too, new technologies (microelectronics in particular) are opening up hitherto unimagined possibilities for substantial improvement in more economical operation, safety and multipurpose use.

It is against this background that the newly merged organization should primarily be viewed at this time. In the long run, it is to develop into a new type of "technology conglomerate."

The annual report lists the combined R&D expenditures of Daimler-Benz, AEG, Dornier and MTU for 1986 as amounting to DM 3.6 billion and the total work force is given as some 20,000. But this does not qualify as genuine integration as yet. The so-called "synergy committee," headed by Edzard Reuter, the deputy chairman of the board, is responsible for coordinating the integration of the various companies which make up the conglomerate. "Cooperation with the new member firms," the annual report claims, "has gone beyond the mere exchange of information and has led to a number of joint projects in the course of the reporting period."

The potential for such projects has emerged in a variety of fields, particularly in electronics, in artificial intelligence and in new energy exploration and technology. A key role is likely to be played by the company's new R&D center in Ulm which is to be established as part of a long-range project designed to take advantage of the AEG operation as well as the university there.

"AEG will concentrate on R&D of longer-term technology projects, especially on information, energy, process and materials and, increasingly, on basic systems," the annual report says. These R&D programs which call for investments in the hundreds of millions are matched by a huge investment project to build a new passenger car plant in Rastatt. By setting up this new plant, the third of its kind, Daimler-Benz hopes "to adapt output to qualitative growth based on new production technologies."

The 38.5 percent increase in the work force of the Daimler-Benz concern to 320,000 and the 25 percent rise in sales to more than DM 65 billion in the space of just one year must thus be viewed in a different light. Although this is not yet a reflection of an integrated business organization, it definitely does amount to more than a simple addition of sales and staff figures.

The trend analysis clearly shows what Breitschwerdt really means when he says (as he has on a number of occasions) that the automobile business will continue to be the core of Daimler-Benz' operations, i.e. that the new technologies will be a decisive factor in determining the competitiveness of Daimler-Benz vehicles and, conversely, that the automobile itself presents unlimited possibilities for the application of the new technologies.

The high profits "were due" to the success of the passenger car division. "As before, increased competition has had an adverse effect on profits by the commercial vehicles sector," the report points out. Still, Daimler-Benz was able "to maintain its position as a worldwide market leader in the production of trucks of more than six tons." It is worth noting that the Daimler-Benz subsidiaries in North and South America succeeded "in making a positive contribution to the profit picture."

The company is not looking for a substantial rise in the number of vehicles sold on traditional markets. Its goals are qualitative growth; cost-effective and flexible production based on standardization of components and better utilization of opportunities in specific markets "as part of a company-wide commercial vehicles program."

Investments in Truck Production

1986 investments for plant improvement amounted to DM 1.8 billion as in the preceding year. In 1986, DM 1.1 billion of this amount (as against DM 1.2 billion in 1985) went into product-related projects and the expansion of production facilities. DM 0.49 billion (as against 0.45 billion in 1985) went into the commercial vehicle sector. An equal amount was invested in commercial vehicle plants located in foreign countries. Domestically, adjustment and restructuring programs will cut into profits for some time to come; but commercial vehicles still are the multinational company's second most important product line.

According to Breitschwerdt, company strategy will focus on high technology and high quality production in order to repeat this year's satisfactory profit margin in the commercial vehicle sector and to stabilize work force levels. As a result of the addition of AEG, which accounts for 17 percent of sales of the conglomerate, the passenger car division's share of total sales declined from 54 percent to 48 percent and that of commercial vehicles from 39 percent to 27 percent. The new Daimler-Benz electronics division (not labeled as such but already a part of AEG and slated to remain there) will focus a good deal of its attention on the truck division.

A good indication of the strength of Daimler-Benz passenger car technology was the fact that Mercedes Benz of America, faced with the weaker dollar, would in theory have had to pay an extra $800 million for the automobiles it imported

from Germany but was able to offset that amount at least in part by instituting three successive price increases totaling 14 percent. Nonetheless, Mercedes sales in the United States rose 14 percent to almost 100,000 vehicles.

Although the commercial vehicles division did not make as much of a contribution to profits as in previous years, the division's profits did increase in 1986 yet once more. Currency shifts tend to obscure the growth in both sales and profits which was primarily due to more sales of higher quality medium class models.

According to Edzard Reuter, the 1986 balance sheet not only strengthens the more obvious reserve assets of the company but its internal reserves as well. He points out with some satisfaction that company assets rose DM 1.9 billion to DM 8.7 billion although this was the year in which roughly DM 1 billion was spent on the purchase of 56 percent of AEG's stock. During the same time frame, the conglomerate's total assets increased by DM 3.1 billion to DM 14.7 billion. In spite of its sizable reserves, Reuter says, the company has no plans for further takeovers. That is not part of Daimler-Benz' strategy; but, he adds, the company does stand ready to act should the need arise.

The most important aspect of the company's plans to secure its future, according to Reuter, are the investments it plans to make. During the upcoming 5-year period until 1992, Daimler-Benz will make investments to the tune of DM 16 billion while the conglomerate will invest DM 24 billion. In 1988, work is to begin on the construction of the new passenger automobile plant in Rastatt and by 1990, the first vehicles will be coming off the assembly line there. During this time period, the Ulm project will begin to take shape and so may the test course. The Daimler-Benz board is no longer counting on Boxberg. In the course of this year, Breitschwerdt says, it will make its final choice of a site from among more than 100 applicants.

Based on the figures available to him for the first 4 months of this year, Breitschwerdt believes that 1987 will turn out to be a "generally satisfactory year once again." Domestic registration of new Daimler-Benz vehicles is down five percent from last year's comparable figures, i.e. one percent below the industry average of minus four percent. By contrast, company exports increased eight percent while the industry as a whole experienced a four-percent drop. To be sure, passenger car production is expected to rise only slightly, to 600,000 vehicles, because output limits have already been reached. Refusal to work overtime as well as token strikes, it is said, resulted in a deficit of 1,700 vehicles which can no longer be made up. The demand for medium class vehicles, which were the big sellers in 1986, could not fully be met by Daimler-Benz. In some cases, delivery times have again gone up to 12 months.

The business outlook for AEG, Dornier and MTU were covered by this news paper in an earlier report.

"If one wishes to be viewed as a pacesetter and not just as someone who follows the leader, "Breitschwerdt says, "one will have to spend more than DM 1 billion on the development of a new and sophisticated generation of passenger cars. The investments for such a program call for almost twice that

amount. Daimler-Benz knows perfectly well what it is doing by mounting such a huge investment program in its automotive divisions.

"Ar Daimler-Benz, foreign currency transactions must exclusively be concluded in connection with definitely agreed upon delivery and production schedules," Reuter says. "It goes without saying that we are carrying out this aspect of our cash and currency management program in collaboration with only a very small number of first-class international banking institutions."

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UK'S CELLTECH ANALYZED, R&D EXPLAINED

Paris BIOFUTUR in French May 87 pp 37-40

[Article by Robert Magnaval, science and technology attache at the French Embassy, London, and Bruno Strigini, head of mission, French Embassy, London: "Celltech: An American-Style European Company"; first paragraph is BIOFUTUR introduction]

[Text] Seven years after its creation, Celltech has become a world leader in the industrial production of monoclonal antibodies. Like Porton International, Agricultural Genetics Company, and the Plant Breeding Institute, Celltech was founded as a result of government interest in applying biological and medical research findings by public institutes in the UK. BIOFUTUR here analyzes one of the rare European high-tech biotechnology companies, Celltech, which will probably be listed on the stock exchange within a few months time.

Since 1983, the relationship between Celltech and its exclusive partner, the Medical Research Council (MRC), have been progressively loosened. However, the company has kept some of the advantages of this initial sponsorship, i.e., exclusive marketing rights for some 15 products developed at the MRC, as well as continued frequent information exchanges with the scientists of this organization.

Celltech has all the characteristics of an American-style biotech company. In 1986 the company had 335 employees (average age 29), including 200 in R&D. Half of its staff have university degrees in science and 30 percent are experienced researchers directing some 10 or more research focuses developed by the company. Annual revenues of the Celltech group and its two joint ventures reached 11 million pounds in 1986. Everything points to the company's becoming profitable within a few months. Celltech's performance is worth analyzing because it is becoming the very symbol of a successful university-industry relationship in the UK.

Company Structure

The founders of Celltech stated their objectives early on: to develop an independent research potential based on the experience of the MRC and British universities, and to ensure the economic future of the products and processes to be marketed.

Collaboration in Product Development

The contractors selected are well-established manufacturers able to assume responsibility for the subsequent marketing phase. Their ability to provide Celltech's products with easy access to Japanese and American--rather than European--markets has been a key element in their selection.

For Japan, Celltech has signed an agreement with the Sumitomo Corporation conglomerate, entrusting them with introducing Celltech technologies to Japanese manufacturers. The British biotech company has thus been able to sign contracts with the Sankyo pharmaceutical firm for joint development of tPA, calcitonin, tumor necrosis factor (TNF), and macrophage activation factor (MAF).

In the United States, Celltech has signed an agreement with Serono (connected to Ares Serono of Geneva) for the development of human growth hormone, and with the American Cyanamid chemical company and its subsidiary, Cyanamid of Great Britain, to develop antibodies for use in cancerology, either to improve imaging techniques or for targeted tumor treatment.

Joint Ventures and Marketing

Celltech joins forces with a manufacturing company as an equal partner to found a third company for marketing of available products. Thus, the Boots chemical group has joined with Celltech in Boots Celltech Diagnostics (revenues of some 3 million pounds in 1986) and so has Air Products Ltd. in Apcel to promote industrial microbiology processes.

These structures are very like those which Genentech in the United States created during the same period for activities peripheral to the company's main focus: HP Genenchem (with Hewlett-Packard), Travenol Genentech Diagnostics (with Travenol), Genencor (with Corning Glass), and GLC (with Lubrizol).

Supply and Subcontracting Contracts

Celltech supplies large amounts of monoclonal antibodies to Ortho Diagnostics (Johnson & Johnson) for use in bloodtyping kits. For this purpose, the U.S. Food and Drug Administration (FDA) granted Celltech its first approval for mass production of monoclonal antibodies from cell cultures. Since March 1986, Celltech has agreed to supply 1 kg of monoclonal antibodies to Hybritech (Eli Lilly) and has sold licences for fermentation processes to APV International.

One of the two joint ventures, Boots Celltech Diagnostics, has itself concluded supply contracts with London International (fertility tests) and Bayer AG (veterinary tests).

Economic and Financial Data

Government holdings in Celltech capital, through the British Technology Group (BTG)--the British equivalent of ANVAR [National Agency for the Implementation of Research]--have steadily decreased since its creation. BTG sold its

remaining 15 percent ownership to other shareholders in 1986. Private investors include pension and insurance funds, the Midland Bank, and the venture capital fund of Biotechnology Investments Ltd. (BIL), whose chairman is Lord Rothschild. Its initial capital was 12 million pounds and its current assets come to 23 million pounds. The company's worth, estimated at 20 million pounds in 1983, was revalued at 55.4 million pounds during recent financial transactions in June 1986.

Company revenues have doubled nearly every year for the last 6 years, rising to 7.6 million pounds in 1986. Along with almost all other biotech firms, the company's balance sheet is still in the red. Losses, which are decreasing regularly every year, now represent 21 percent of turnover. However, if the Celltech group's results are considered as a whole, including its share in Apcel and Boots Celltech Diagnostics and income from invested capital, these losses represent only 10 percent of total revenues.

To truly establish its marketing activity and benefit from the expertise of its manufacturing partners, Celltech has deliberately turned towards the United States and Japan, where it makes 90 percent of its turnover. Celltech intends to do even better in the future, with profits of 500,000 pounds in 1987 and 1.5 million pounds the following year.

Six years after its creation, Celltech's financial results must be evaluated in comparison with the American biotech companies. Revenues from research contracts increased considerably in 1986, yet there has always been the concern to negotiate conditions which would not weaken the company if the agreement were prematurely broken. Moreover, the overall balance between income from these services and that from the sale of monoclonal antibodies places the company in a good position in relation to the other companies in the sector (see table 1).

Products and Technologies

Faced with tough competition from several companies, Celltech has been forced to redirect its activities. A producer of antibodies, a very high added-value item selling at 1,300 pounds per gram, Celltech has sometimes had to limit its role to that of an intermediary, merely supplying proteins to other companies better placed to market them.

Dominating the Technology

In 6 years, Celltech has multiplied its cell culture capacity by five; three 1,000-liter fermenting units are operational and a 2.4-million pound investment in 1986 made it possible to construct buildings which can house several 10,000-liter fermenting units.

This infrastructure enables the company to produce monoclonal antibodies used throughout the world for immunopurification of interferons and interleukines and for blood typing. In addition, in its role as a service company, Celltech makes its facilities available to third parties wanting to mass-produce a specific protein from a modified cell strain.

Among Celltech's clients are the above-mentioned commercial companies in the diagnostics sector: Ortho Diagnostics (Johnson & Johnson), Hybritech (Eli Lilly), and the jointly held companies Boots Celltech and Apcel. Total income from this activity has grown from 1 million pounds in 1984 to 2.7 million pounds in 1986. It is estimated that world production of bulk monoclonal antibodies in 1986 was 14 to 15 kg, with Celltech supplying more than 2 kg per year.

Focuses of Development in the Health Sector

The products, their development stage, and the companies involved are given in table 2.

Plasminogen activator (tPA) is an excellent example of the keen competition in this sector. Apart from the traditional manufacturers of urokinase and streptokinase, some 20 companies work in this field, either directly with tPA or in the development of similar products: Eminase from Beecham (UK), a single-strand protein from BioResponse, synthesis from epithelial cells rather than melanomas from the Porton group (UK) and kPA from Collaborative Research (Sandoz). Genentech is one of the most serious competitors in this field. The company dominates in large-scale production of this new fibrinolytic product with its 10,000-liter fermenting unit and it has a policy of taking out patents internationally. Genentech has already launched its phase III tests, whereas Celltech, collaborating with Sankyo on this product, is beginning its preclinical tests. Sankyo, which has obtained international exclusive rights for tPA from Celltech, will probably not be able to market this product outside of Japan. Celltech therefore risks being able to enter this world market, estimated at 500 million pounds by 1990, only as a subcontractor.

Eighty percent of the calcitonin marketed is extracted from salmon. The main producers are USV (Rorer) and, in Japan, Yamanouchi and Toyo Jozo. Its field of application for the treatment of Paget's disease (Footnote 1) (Deforming osteopathy, local or widespread, of unknown origin) and hypercalcemia has been extended to post-menopausal osteoporosis. Twenty million women in the United States suffer from these symptoms and the present 100 million-pound market should grow considerably. Management at California Biotechnology estimates that it will increase tenfold by 1995.

Research on synthesizing the hormone chemically or by genetic engineering should eliminate the allergic reactions observed in cases of long-term treatment by calcitonin of animal origin. Celltech is collaborating with Sankyo on this product which is at the preclinical stage. However, Ciba Geigy is already offering a synthetic calcitonin in Europe.

The research program on the Calcitonin Gene Related Product (CGRP) has been picked up by Celltech following promising university work carried out by laboratories associated with the company. Experiments carried out in 1987 should ascertain whether this substance could be effective in the treatment of high blood pressure.

With human growth hormone (hGH), Genentech has taken advantage of a very favorable combination of circumstances to launch its "Protropin": The hormone

extracted from the pituitary glands of corpses has in fact been withdrawn from the American and British markets since 1985, following viral contamination of patients. (Footnote 2) (BIOFUTUR No 43, Feb 86 p 46; No 55, Mar 87 p 60) At the same time, Genentech obtained the privileged "Orphan Drug" treatment from the FDA, giving "Protropin" a clear advantage on the American market. However, it should be noted that "Protropin" is a human growth hormone with a supernumerary methionine. While Celltech and Serono have produced somatotropin--the real human growth hormone--without an extra methionine and are testing it in 30 American medical centers in hopes of extending its field application, the FDA's attitude towards this product will be decisive in determining its commercial future.

In the field of cancer treatment, Celltech, together with Sankyo, has abandoned research into the tumor necrosis factor (TNF) and is continuing research into the macrophage activation factor (MAF), an antitumor agent. Celltech has patented a productive cell line but is faced with competition from two pharmaceutical groups: Smith Kline and Hoffman-La Roche. In 1986 Celltech teamed up with American Cyanamid and thus found a significant partner for cancer research. This market is estimated at 1.3 billion pounds by 1995. By then, monoclonal antibodies can be expected to hold 15 percent of the market, i.e., 200 million pounds. The initial financing of the program, 5 million pounds over 2 years, projects the development of selective antibodies to localize and follow tumor growth. Hambrecht and Quest in the United States have estimated this market to represent about 450 million pounds for Centocor. Likewise, conjugated molecules will be produced for the selective treatment of certain tumors. The tissue inhibitor of metalloprotease (TIMP) studied by Strangeways Research Laboratory of Cambridge (UK) was recently produced in large amounts by Celltech. This protein could resorb the proliferation of the connective tissue in the case of cancers or arthritis and Celltech is at present negotiating an industrial development agreement.

Celltech's Future

The coming sale of Biogen's Geneva offices will make Celltech the only European biotech company with over 4 million pounds in revenues. If the company were assessed using the criteria proposed by Stelios Papadopoulos of Donaldson, Lufkin & Jeurette, the highest marks would go to the three factors suggested by Mr Papadopoulos: control of the technology, quality of management, and overall strategy. However, analysis of product lines under development has shown that it is not easy for a small company to get started on time in the American market when it comes from Europe. A similar American company would have been quoted on the stock market much earlier, thereby obtaining considerably higher injections of capital.

Nevertheless, the encouraging turnover forecasts for the company in 1987 and 1988 will facilitate its introduction on the London Stock Exchange within a few months. Otherwise, with its highly developed technology and top-of-the-line products, Celltech would be tempting prey for a well-placed pharmaceutical or petrochemical firm.

Table 1. The Relative Importance of Research Contracts in the Turnover of Biotech Companies

Company	Sales Percentage	Research Contracts Percentage	Turnover Total (millions of pounds)
Amgen	4	96	14,100
California Biotechnology	0	100	5,000
Celltech	47	53	7,600
Centocor	35	65	13,300
Cetus	6	94	26,400
Chiron	11	89	4,800
Genentech	6	94	54,000
Integrated Genetics	0	100	4,000
Molecular Genetics	22	78	4,100

Table 2. Celltech R&D in the Health Sector (Source: James Cook, Wood Mackenzie & Co. Ltd., London)

Products	Partners (R&D)	Project Start	Launch (approx.)	Potential Market (millions of pounds)
1. tPA	Sankyo	Sep 83	1991	530
	Competitors: Asahi, Beecham, Biogen (Smith Kline), BioResponse, Cheil Sugar, Chiron (Hoechst), Ciba Geigy, Codon, Damon, Genentech, Genetics Institute (Wellcome), Green Cross HEM Research, Integrated Genetics, KabiVitrum, Kanegafuchi, Lilly, Menarini (Creative Biomolecules), Mitsui Toatsu, Moshida, Porton International, Sanofi, Yamanouchi, Weizmann Institute			
2. Calcitonin	Sankyo	Sep 83	1991	265
	Competitors: Amgen, Genentech, Rockefeller University, Suntory, Unigene			

Products	Partners (R&D)	Project Start	Launch (approx.)	Potential Market (millions of pounds)
3. hGH	Serono	Jan 84	1988	65
Somatoliberine	Competitors: Chiron (Ciba Geigy), KabiVitrum, Roche, Salk Institute, Sanofi, Takeda, Unigene			
Somatomedine	Competitors: Amgen, Biogen, Bio-Technology General, Chiron, Fujisawa, Genentech, Smith Kline			
Somatotropine	Competitors: Bio-Technology General, California Biotechnology, Cheil Sugar, Chiron, Hoechst, KabiVitrum, Lilly, Nordisk, Sanofi			
Somatrem	Competitor: Genentech			
4. MAF	Sankyo	Sep 84	1995	265
	Competitors: Smith Kline, Hoffman-La Roche			
5. TNF	Sankyo	Sep 84	abandoned	-
	Competitors: Asahi Chemical, Biogen, Cetus, Chiron, Genentech, Hayashibara, Nihon Seiyaku, Interferon Sciences (NPDC), Sclavo, Wardley Institute			
6. Image/Cancer monoclonal antibodies	Cyanamid	Apr 86	1990/1991	330
	Competitors: Biotech Research, Boehringer Mannheim, Immunomedics, Quidel, Xoma			
7. Cancer therapy monoclonal antibodies	Cyanamid	Apr 86	1995	2,000
	Competitors: Biotech Research, Boehringer Mannheim, Bristol Myers, Centocor, Damon Biotech, Immunomedics, Johnson & Johnson, Lilly, Merck & Co., NeoRx, Quidel, R. Bellon, Sanofi, Seragen, Stanford, Takeda, Teijin, University of California, Xoma			
8. TIMP	-	-	1995	-
	Competitors: Sandoz, Synergen			
9. CGRP	-	-	1995	-
	Competitors: Research just beginning			

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25041
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EUROPEAN INVESTMENT BANK PRIORITIZES EUROPEAN HIGH TECH

Amsterdam COMPUTERWORLD in Dutch 9 Jun 87 p 20

[Article by Jan Schils: "European Investment Bank: Regularly More Credits for Advanced Technologies"]

[Text] Brussels--For the last 3 years the European Investment Bank (EIB) has made available almost 2.5 million guilders for the development and application of advanced technologies in the EEC. This has been consistent with the EEC priority for promoting high technologies to improve the competitive position of European industry.

According to an EIB staffer, the EIB's Board of Governors had already recommended advancing credits for high-tech projects during the annual meeting of June 1984. It was then decided to grant credits to projects involving real spearhead technologies, or to projects aiming at the production of new technologically advanced products in the European Community (product innovation) or leading to new production processes (process innovation).

Industrial Cooperation

The EIB has thus paid special attention to projects providing industrial cooperation between companies in different EEC countries. In this way duplication can be avoided and the size of the European market can be used to best advantage.

As is well known, recognition of the importance of modern technology for industry has led to a number of European programs in the fields of information technology (ESPRIT), communication technology (RACE), basic research in industrial technology (BRITE), science and technology (FAST), and cooperation in S&T research (COST).

There are also other less well-known programs in the EEC and its member countries in such fields as biotechnology, aeronautics, and energy supply. Finally, there is also the EUREKA project with 19 participating countries which will certainly arouse the interest of the EIB.

There are many sectors and products that qualify for EIB credits, including office automation, data processing, data communications, electronic circuits,

microprocessors, optoelectronics, and companies that manufacture advanced machine tools (robotization, automation, and advanced materials).

Olivetti: 200 Million Guilders

For the past 3 years credits granted by the EIB for high technology have been increasing both absolutely and relatively on a regular basis. There are few branches of industry that cannot benefit from the introduction of high technologies. Thus, the projects supported by the EIB vary widely.

One of the most remarkable loans granted by the EIB involved 200 million guilders to Olivetti for the automated production of professional PC's and the introduction of computer integrated manufacturing (CIM). This was not the first office automation and data processing project supported by the EIB, but it is the largest in its kind thus far. It is also an example of what can be done to keep European industry in a leading position.

Also interesting was a credit of almost 180 million guilders to Philips for the partial financing of the megachip project. Philips is investing large sums to acquire submicron technology, i.e, the technology for the production of next generation integrated circuits.

The first of the new generation circuits is a static 1-megabit semiconductor memory. It is common knowledge that the megachip R&D is a joint project by Philips and Siemens.

The EIB is also contributing funds for the construction of an integrated circuits factory for European Silicon Structures (a EUREKA project). Several companies are involved, including British Aerospace, Brown Boveri, Bull, Olivetti, Philips, Saab, Scania, Telefonica, Telfin, and various investment companies. The new factory will manufacture only custom-made application-specific circuits.

Finally the EIB extended a credit of 175 million guilders to the European organization for telecommunications satellites (Eutelsat) to finance construction and launching of a second generation of telecommunications satellites. The new, higher-capacity satellites will gradually replace their predecessors from 1989 onwards.

25017
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FRENCH COMPUTER LOBBY CALLS FOR LIBERALIZATION OF TRADE

Paris ZERO UN INFORMATIQUE in French 18 May 87 p 2

[Article by Christine Peressini: "What Is New with the Computer Peripherals Club?"]

[Excerpts] The Club de la Peri-Informatique Francaise [French Computer Peripherals Club], to which most French manufacturers and SSII's [Data Processing Services and Engineering Company] other than Bull belong, is urging French manufacturers to adopt an American-style liberalism based on the implementation of major strategic projects. This proposal is contained in a charter which the national manufacturer [Bull] wishes to endorse.

This association, governed by the law of 1901, currently includes--with the exception of Bull--most small and medium computer firms whose corporate headquarters are in France.

This represents 50 firms doing business in some 40 countries and involved in the development of the French computer industry--32 hardware manufacturers (active members) and 18 SSII's (associate members)--whose combined 1986 turnover came to Fr 11 billion, with a total manpower of 11,000.

The association is not only a forum for its members, it also aims to be the industry's representative vis-a-vis the government--which was in favor of its establishment--as well as the industry's representative vis-a-vis the major users associations and the European authorities.

The French Club, Founder of the European Association

The club is becoming a lobbying force in the technical, economic, and political fields, according to D. Blonde. It is one of the organizations that the ministries must consult and it maintains continuing relations with the Ministry of Industry. Traditionally, the representative of the ministry attends each board meeting of the club and gives a project status report at the start of the meeting; club members in turn offer their off-the-cuff reactions.

The French club was behind the establishment of the EIII, the European computer peripherals association, for which Dominique Bonelli serves--as he does for the French association--as general secretary. The European

association includes the French, English, German, and Benelux clubs. The members (96 European firms) employ approximately 70,000 and produce 3 billion ECU's in goods.

The aim is to constitute a representative and lobbying force at the Community level. That, however, requires being present, which in turn "poses a problem of funding," according to Blonde.

Twice a year the club issues a publication called LES CAHIERS DE LA PERI-INFORMATIQUE which includes papers by the various committees: office automation, components, export, networks (standardization information), services (formerly, the maintenance committee), and public relations. The committees enjoy the collaboration of over 250 representatives from the member firms.

Among the chairman's point of pride, there is, first of all, the club's "charter" for a new governmental policy. The text, drawn up just before the 1986 elections, defines the position of French industry relative to liberalism or "freedom of competition" within a resolutely European context.

The need for a governmental industrial policy is clearly stated--one that will give preference to European firms and, within Europe, favor French firms.

In particular, there is the need for "major strategic multidisciplinary projects obliging us to go beyond the current state of knowledge, and whose scope implies collaboration with other firms." Furthermore, a "European SDI five or six times as important as EUREKA would be welcome."

To ensure the trickle-down of the beneficial effects of such major projects throughout industry, large companies which have benefited from public funding must be obliged by contract to award 30 percent of their subcontracts to small- and medium-sized firms--based on the U.S. Small Business Act. To quote Blonde, "Our companies are competitive so we do not expect subsidies to survive. When we ask for governmental financial assistance, we ask only to benefit from normal conditions of competition. The government in its role as promoter asks us to go beyond the current level of technology. The money paid by the government to ensure Bull's financial equilibrium, and which has nothing to do with what we are seeking, cannot be used to the advantage of the computer sector."

Getting Better Known

The charter has been adopted by the European clubs as a working document for the European committees. Furthermore, as Bull wants to join, club representatives and Bull representatives will submit the document jointly to Alain Madelin. If the three parties are in agreement, an official signing would seal the final phase. The second source of satisfaction for the "Peri" club's chairman is the club's recent communications campaign, which is directed not only to the outside but also internally, "to motivate members to think in 'club' terms and strive to increase their firm's power and not merely its performance."

In addition, the club has become an "institution" which is fully recognized by the government. For example, Alain Madelin, minister of industry, postal services, telecommunications, and tourism, who chaired its general assembly last November, paid tribute to the club at the inauguration of the 1986 computer convention, as did Jacques Chirac in his opening speech at SICOB last fall. Alain Carignon, minister of the environment and mayor of Grenoble, offered to sponsor a meeting of decisionmakers organized by the club and by the Isere General Council. The meeting should be held in Grenoble at the end of the year on the topic "Comments about the future."

Also noteworthy is "the more systematic nature of SSII participation within the association, thereby increasing the scope of the information exchanges held there."

Three committees (office automation, networks, and public relations) are chaired by SSII representatives. In addition, the SSII's are represented on the club's board of officers--by the Syntec vice chairman, more specifically--and on its council.

The club's relationship with Bull "has become quite friendly," according to Blonde. "In Brussels, for example, we also rely on Bull representatives. That firm is still "a serious competitor but is no longer an adversary for us."

In short, there is collaboration with Bull every time the national interest is at stake. "Cooperation has become the rule far more than conflict except in isolated instances."

Club de la peri-informatique francaise, 12, rue de Lincoln, 75008 Paris, phone: (1) 42 56 47 30

25050
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STRENGTHS OF PHILIPS FRANCE EXPLAINED

Paris L'USINE NOUVELLE in French 11 Jun 87 p 26

[Article by Claude Amalric: "Philips France: The Meyer System"; first paragraph is L'USINE NOUVELLE introduction]

[Text] Hazy structures, conservatism, and routine.... Philips France was losing ground. The bolts needed tightening. Summoned to Eindhoven in 1983, Thierry Meyer has rejuvenated the company.

Nothing is easier than obtaining information concerning the French Philips company results and market shares in practically all its areas of activity: Just ask Thierry Meyer, its chief executive officer. Ask Thomson's consumer-oriented branches the same questions or recall the former reactions of Philips, and you will realize how revolutionary this transparency is....

It was put to the test at the first presentation of Philips France's results on 4 June. What an event! With a staff of 29,568 and Fr 21.3 billion in revenues last year, this group of about 20 companies and 32 factories, ranking 17th in France in turnover, had carefully maintained a cloud of uncertainty about its holdings and kept totally silent about its figures from the outset. "Only a few financiers could make any sense of them, if at all," comments an executive. The complexity of its structure resulted from the acquisition after 1921 of many companies grouped around La Radiotechnique, each with its own status and no other common factor than the production of radio and sound components.

There was no way out! CGR, a medical subsidiary of Thomson, was dying out under very similar circumstances: A good market segment, companies acquired because they were up for sale, but building up into a shapeless, costly muddle as the years passed. Before being resuscitated by Jean Segui, CGR was sinking under the weight of 20,000 persons in 200 independent companies. There remain 6,300 (still too many) in several lines of business, but profits have returned.

Relatively speaking, the parallel between Philips France and the Thomson subsidiary applies throughout. Hazy structures benefit technocrats and crusty old bureaucrats anchored in jobs they alone know. The law of silence then prevails, as does the observance of precedence over efficiency. Dynamic young graduates were deserting Philips.

Eindhoven became frightened when the results, which had been very good until then, plummeted after 1978. They barely broke even in 1983 and 1984.... Under the Japanese onslaught, Philips France was in desperate trouble. Recalled from Argentina in September 1983, the Swiss Thierry Meyer arrived.

After 3 months of analyses, 6 months of studies, and a year of restructuring, the Meyer system was in place. Its author describes it as "decentralized decisionmaking with fewer hierarchical levels to bring the decisionmaker closer to the customer," combined with a rejuvenated staff and efforts to improve internal and external communications as well as quality and productivity. A lot to be done in a short time....

The results are already apparent. Net profits rose from Fr 308 million in 1985 to Fr 698 million, or 3.3 percent of the turnover, in 1986. The current result is Fr 1.1 billion, "excluding exceptional results," insists Pierre Steenbrink, general and financial director of the French Philips company. "This 3.3 percent is better than Philips' average worldwide, but our major competitors are doing better. We must arrive at 4 percent of the turnover at least," remarks Thierry Meyer. He also notes that last year was exceptional for television sales.

Within the consolidated net result, the RTIC subsidiary has the largest share with Fr 212 million, half of which comes from Philips, Schneider, and Radiola television sets (Grundig, wholly owned by Philips, is independent of Philips France). However, 1987 looks less promising: Television sales are down 20 percent in the first 4 months. This makes Thierry Meyer cautious about the current year. "But the increase in results due to the 1985 in-depth restructuring will not be affected: It shows that it is possible to compete by becoming more flexible, and more expeditious," he adds, rightly proud of his work.

Philips' share in the French consumer electronics market, predominantly consisting of television sets, was eroding after having reached 40 percent "long ago." Last year the company noted that the decline had been arrested and stabilized at 31 percent. The renewed offensive in high fidelity, following the inception of compact disk players, is certainly playing its part. This is only one aspect of the general streamlining of the company provided by the clear and light structure that has been operational since January 1986. Philips France has again become an economic war machine with defined tasks and immediate reaction to requirements. Sure of its strength, it is no longer afraid to show it.

25046
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PHILIPS INTEGRATING WORLDWIDE INFORMATION MANAGEMENT SYSTEMS

Amsterdam COMPUTERWORLD in Dutch 16 Jun 87 p 19

[Article by Willem Koole: "Unmanned Computing Centers Part of Multibillion-Guilder Investment"; first paragraph is COMPUTERWORLD introduction]

[Text] Amsterdam--In the years to come, the worldwide Philips organization will be working hard to create an infrastructure as flexible as possible to integrate the numerous computer systems into one network. In principle, this will allow Philips employees all over the world to communicate with one another. "This will involve 2 percent of the turnover or more than 1 billion guilders," said G. Jeelof, vice president of the board of directors, at the FINANCIAL TIMES World Electronics Conference in London.

During a DPCE Computer Products symposium for MIS managers at the Hilton in Schiphol, W.J.J. Kersten, EDP director of the Nederlandse Philips Bedrijven [Netherlands Philips Companies], discussed at length Philips' automation plans. He said that in 25 years the computing center had developed into DP Network Services, an internal services organization serving the entire concern. Every division of the concern can buy its services, without obligation.

Over the years the organization has clearly shifted its attention from technology to information management, which is also an integrated part of the independently operating department.

Complexity

Around 1980, DP Network Services management was faced with an enormous increase in the use of computers and communication facilities. The range of services was also expanding. Due to the increasing use of on-line computer systems, personal computers, and worldwide applications, greater demands were placed on service quality.

At the same time, management was increasingly concerned with the problems of cost control and complex systems management. "The more systems are connected to a central processing unit, the harder their management becomes," says Kersten. Moreover, remote computer use made DP management more vulnerable and visible to a larger number of employees.

Twin Center Concept

In 1980 the "Twin Center Concept" was introduced. In the meantime, three of these modern computing centers have been built and plans for a fourth center are almost complete. Each center has at least two central processing units which can take over the other's work if one breaks down. The connections between the centers also enable them to act as backups for each other.

Breakdowns are handled at three levels: immediate repair while the computer is processing, restart of a defective computer or database within 2 hours, and, in case an entire center breaks down, renewed access to capacity and information within 48 hours.

Philips also wants to reduce its dependence on the geographical site of the centers. This is one of the reasons why it is planning to build unmanned centers which can easily be protected. These centers only have to be visited when the hardware needs repairing.

A minimum of standardization is considered necessary. Although the first two centers were equipped mainly with IBM 3090 systems operating under MVS and the third with Amdahl 5860 computers under VM in combination with an IBM 4381, MVS has now been selected as the standard.

Continuity

Major features of the future Philips infrastructure will be physical and geographic decentralization on each architectural level and centralization of management and maintenance. Furthermore, the computing centers must be able to operate around the clock because in the Philips world the sun never sets.

This target has almost been achieved because over the past 4 years the up-time ratio increased from 80 to 95 percent. At the same time, availability of the computing capacity rose from 89.3 to 99.9 percent and costs were reduced to 40 percent of the 1983 level.

Other characteristics include centralized software distribution and support, a transition from computing centers to data centers, and standardization. The storage capacity, which increased from 120 to 507 gigabytes between 1982 and 1986, is expected to reach 930 gigabytes by 1988.

Kersten thinks it is useless to hold on to the idea of a cyclical movement from centralization to decentralization and vice versa. He prefers an overall system, with constant evaluation of the parts, that are or are not suitable for decentralization. In all Philips now has 55 interconnected computer centers, including 14 in the Netherlands.

Kersten is also determined to continue the automation of center management. "If traditional management is continued, more than half of Philips' staff would soon be working in its own computing centers!"

In his opinion, the device for automated computer tape input, developed by Storage Tek, is a good concept for automation. VIO, an earlier product of the

same company, however, was not a success. Its basic idea was good, but its architecture differed too much from existing ones.

In addition to well-considered automation, practical management disciplines are becoming increasingly important in computing or data centers. There is a need for management information systems for the information management infrastructure. According to Kersten, spreading out risks and reducing the human error factor are major management goals because they lead to consistently high quality levels.

25023
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EUROPEAN FAMOS PROJECT ACQUIRES EUREKA LABEL

Paris ZERO UN INFORMATIQUE in French 9 Jun 87 p 43

[Article signed A.M.V.: "FAMOS Project: Under the EUREKA Banner"; first paragraph is ZERO UN INFORMATIQUE introduction]

[Text] The last meeting of the FAMOS European steering committee, held in Toulouse in May, took stock of current projects, about 30 in all.

The FAMOS research and development program originated from a French-German initiative in 1985. Its goal is to promote automated and flexible assembly systems. It acquired the EUREKA label at the conference of ministers held in Stockholm in December 1986.

This program now involves seven countries. In July 1985, Austria, Spain, Italy, the UK, and Sweden joined the two promoters of the project: France and the FRG. The organizational structures at the European level comprise a steering committee with two representatives from each country (one administrative and one official in charge of the technical aspects of the project) and a working group drawn from the national working groups.

In France the FAMOS project is led by a working group associated with a monitoring and steering group under the auspices of the Ministry of Research and Higher Education as well as the Ministry of Industry, Postal Services, Telecommunications, and Tourism.

As in the FRG, where participation rests essentially on the Stuttgart Institute of Automated Production, the CNRS [National Center for Scientific Research] in France staffs the working group in charge of the preliminary FAMOS phase.

The CNRS works through research centers: the Center for Robotics in Ile-de-France, the Institute for Intelligent Machines in Grenoble, the Institute for Computer-Integrated Manufacturing in Besancon, the Computer-Integrated Manufacturing Public Interest Group (GIP) of Midi-Pyrenees (Promip) in Toulouse. Partners, such as ADEPA [Association for the Development of Automated Production], CERT-ONERA [Toulouse Study and Research Center - National Office for Aerospace Studies and Research], and private companies, are associated with these research centers.

The monitoring and steering group in turn includes some 10 industrial companies (Bull, Compagnie Generale de Productique, Matra Datavision, Merlin Gerin, Peugeot SA, Regie Renault, Renault Automation, SGN [General Company for New Technologies], Sormel, Thomson, Telemecanique), representatives from institutions, and research centers.

FAMOS projects linked directly to automated assembly in industry and designed to result in the implementation of pilot production systems are EUREKA projects, and are thus open to partners of the other 13 EUREKA countries.

Eight French companies presented assembly projects at this meeting: Merlin Gerin in the field of contactors, Philips France in washing machines, Telic Alcatel in electronic boards, Thomson Electromenager in small electric motors, Valeo in clutches, Dassault in riveting, Imbert in footwear, and Thomson Semiconducteurs in electronic chip packaging.

Jean-Pierre Forestier, official in the department for computer-integrated manufacturing, instrumentation, and sensors at the Ministry of Research and national FAMOS coordinator, expects to present about 10 European projects at the next interministerial EUREKA conference to be held in Madrid on 15 September 1987.

The first series of FAMOS pilot operations will be selected at this occasion.

25053
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STUDY RECOMMENDS MASSIVE SUBSIDIES FOR ELECTRONICS INDUSTRY

36200310 Frankfurt FRANKFURTER ALLGEMEINE in German 22 Jul 87 p 9

[Unattributed report: "DM35 Billion By The Turn of the Century/Risks Too High for Companies/Microelectronics 2000"]

[Text] Frankfurt, 21 July--In future, the city was to provide massive support to the German producers of electronic components. This prompted the study "Microelectronics 2000," which was prepared by industry, higher education, and institute representatives at the suggestion of the Ministry for Research and Technology. It is one of four studies to be included in the government's formulation of a concept for the future in information technology. A large number of representatives from Siemens AG, VDE/VDI (Verband Deutscher Elektrotechniker/Verein Deutscher Ingenieure)-Gesellschaft Mikroelektronik (GME) participated in the presentation of the study in Frankfurt.

The authors of the study consider it "urgently necessary" that industry expenditures on research and development until the turn of the century, some DM12 billion, "largely" be covered by support measures. Moreover, the semiconductor industry should be relieved of the burden of over DM14 billion in additional investments occurring during that time frame by means of "further monetary measures." Finally, "flanking measures" should be taken for basic research and for the "adequate building-up" of the subcontracting industry. This is justified with the key role of microelectronics in the national economy. According to Hermann R. Franz, a board member at Siemens, raw materials-poor West Germany needs the "microelectronics resource" to ensure its economic strength for the next century. Microelectronics helps devices and systems as well as technical functions and processes achieve qualitatively new features. Through its role as pacesetter, an efficient semi-conductor industry opens economic opportunities that would go far beyond its own net product.

By the turn of the century, the production volume of the microelectronics industry would therefore have to correspond at least to West Germany's own market demand. This would require "extraordinary" advance payments for research and development and "extremely" high investments, which this branch of industry, despite its bonds with large companies, would not be able to raise on its own "for business reasons." For until the capital paid interest, said Franz, such a "drastically long time" would elapse that even risk-loving

companies like Siemens would be overstrained. Franz drew attention to the fact that it was not a matter here of subsidies for a traditional branch of the economy that has fallen onto hard times, but rather of a "political and economic switch point" for a highly industrialized country that would lose this claim without microelectronics. It was for this reason that Japan and the U.S. also would provide massive support to this industry.

According to the study, only around 40 percent of the microelectronic market in western Europe can be supplied by European semi-conductor manufacturers. For the remaining 60 percent Europe is dependent on manufacturers overseas. This dependence presents an "unacceptable danger," however, for all industrial branches that depend on information technology; for the free, unrestricted access to modern microelectronic products and techniques could be curtailed by security interests in the U.S. and by global objectives in industrial policy in Japan.

13233

FRANCE, NETHERLANDS USE ELLIPSOMETRY FOR CHIP ANALYSIS

Frankfurt/Main FRANKFURTER ZEITUNG/BLICK DURCH DIE WIRTSCHAFT in German 17 Aug 87 p 8

[Article by khl: "LEP and Philips Improve Chip Process Control: Spectral Ellipsometry Provides Resolution of 10 Square Microns"]

[Excerpt] The "Laboratoires d'Electronique et de Physique Appliquee" [Laboratories for Electronics and Applied Physics (LEP)] in the French city of Limeil-Brevannes, working together with international Philips Research has developed a highly accurate optical procedure for analyzing the surface and interfaces of semi-conductors (we reported briefly on the process on 4 June). This process is based on ellipsometry, with which changes in the polarization of light reflected on the surface of a compound are measured. The experimental set-up combines the advantages of spectral ellipsometry, for which the wave length can be fine-tuned from 0.25 to 2 microns, with high local resolution. Using a highly focussed beam of polarized monochromatic light, optical resolution of 10 square microns can be achieved. This measuring device can be used to conduct both two-dimensional position scanning (spatial resolution ellipsometry) as well as energy scanning (spectral ellipsometry), or even combined energy/position scanning. A comprehensive software program has been developed with which ellipsometric cata can be quantitatively analyzed.

For further development it is necessary to test whether component properties are uniform over the entire chip, as well as whether they are reproducible form chip to chip. For this reason the importance of the processes for determining and testing material properties with high sensitivity and good spatial resolution capacity takes on increased significance. In order to bring the characteristics of the components and the chip into direct relationship with one another, a non-destructive process is necessary.

This new form of spectral ellipsometry looks promising for this purpose. It has already been used to check the purification and etching process for gallium arsenide. Surface discrepancies caused on the atomic scale by chemical processes have been revealed using ellipsometric imaging. It has been possible to modify processes to minimize any surface anomalies that they cause. Another test has demonstrated how decisive the quality of the surface or interface can be for the electrical properties of a component. In this test, the chip was analyzed after each step of the manufacturing process (MIS-structure on gallium-indium-arsenide).

In the process it turned out that there is a direct relationship between the electrical capacity of this component and the thickness of the semiconductor/dielectric interface measured with ellipsometry. Furthermore, it has been possible to identify the specific process that was leading to poor quality and lack of uniformity in the component. These few examples clearly show how important spatial resolution spectral ellipsometry is for further development of microelectronics.

13127
CSO: 36980620

NEW ESD MANAGER EXPLAINS STRATEGY

Paris L'USINE NOUVELLE in French 18 Jun 87 p 38

[Interview with Bertrand Daugny, CEO of Electronique Serge Dassault, by Jean-Pierre Casamayou and Jean-Pierre Jolivet: "Electronique Serge Dassault: Priority to Austerity"; date and place not given; first paragraph is L'USINE NOUVELLE introduction]

[Text] CEO of Electronique Serge Dassault (ESD) for the past 6 months, Bertrand Daugny, 62, a graduate of Supelec [Higher National School for Electrical Engineers], has a sense of belonging. The successor of Serge Dassault is betting on continuity. In an interview with L'USINE NOUVELLE he explains himself and specifies his company's objectives.

L'USINE NOUVELLE [UN]: What are your priority goals? Are you going to redefine strategic choices?

Bertrand Daugny [BD]: There are no major changes to be expected, for I have been running this company for more than 30 years. Our firm can live only if it sells. That is why the first and most important option is to define technologies and hardware configurations that will enable us to remain competitive beyond the year 2000. If we make a mistake, we will die. The second goal is to generate sufficient margins to fund this hardware research ourselves. We must make up for insufficient R&D funding by our French and foreign customers. For this reason, austerity in management remains my first priority.

Finally, our third focus is diversification of our major customers, both military--the Army and Navy--and civilian--banks and the post office.

[UN] Which military activities will be expanded?

[BD] Electronic countermeasures: 1987 revenues should be tripled to reach Fr 450 million. Then, radar activity, where the range of the Antilope V designed for the Mirage 2000-N will be increased. We will produce 40 radars for fighter planes and another 140 for various other aircraft.

[UN] In defense electronics this is a time for mergers and alliances. Do you think you can escape this phenomenon?

[BD] Yes and no. In large groups such as Hughes or Thomson, divisions comparable in size to our company employ between 1,500 and 2,000 engineers. We have 2,600 engineers in a staff of 4,100, and 4,000 people are working for us as subcontractors. Thus, we are the largest producer of seeker heads outside the United States. However, mergers generate funding for research and market expansion.

[UN] Are your R&D resources sufficient?

[BD] In this field nothing is ever sufficient. We use our resources very sparingly. Since we have less than the "big players," we must avoid mistakes. Consequently, we are extraordinarily cautious, because we have no right to error.

[UN] How can you be both an associate and a competitor with Thomson?

[BD] That is extremely simple. For example, we have two-way cooperation in Mirage 2000 radars. Thomson is the prime contractor for the RDI radar of the aircraft's interceptor version and ESD cooperates. For the penetrator version, the 2000-N, the reverse is true. We are the prime contractor for the Antilope V radar, with Thomson being our collaborator. Likewise, we have agreements in the field of electronic countermeasures. However, we are competitors for the radar of the future fighter plane derived from the Rafale.

[UN] Does ESD suffer from the slump in military aircraft sales?

[BD] I think this difficult situation is temporary. In the West, 3,900 planes will have to be replaced by the year 2000. Forty percent of them come from us. It is unthinkable that we should not have our share in this market. In addition, the Air Force regularly orders 30 to 40 aircraft per year, which is very important to us. Finally, our computers and digital communication systems are installed in aircraft carriers, Leclerc tanks, and other carrier vehicles. Although the situation is worrying, it is far from being dramatic.

[UN] Nevertheless, new orders are slightly down. How do you plan to react?

[BD] Admittedly, orders in 1986 were Fr 400 million short of our expectations. Nevertheless, our order book represents 2.2 years in revenues. That is not too bad. We hope to have orders worth Fr 8.7 billion by the end of 1987 as a result of the geographic distribution of our customer base....We are focusing our commercial development on new countries. In military sales, we have succeeded in getting a fine contract in Spain. In the civilian area, we are going to South America and Asia. India, for example, has very large markets for transportation.

[UN] Your civilian activities already account for 20 percent. Do you plan to expand them further?

[BD] Yes. We made Fr 781 million in 1986, and we envision Fr 900 million this year. Our objective is to see the automation division finance its own development by generating the margins necessary for self-financing. This will lead us to an annual growth that cannot realistically exceed 20 percent.

[UN] Will conversion into subsidiaries be considered in the long run?

[BD] Naturally. It is even desirable to make the automation division a 100 percent subsidiary, but without opening the capital stock to other partners. The reasons are basically psychological and account related: The product development cycles and their funding are indeed different. The aeronautics sector is characterized by small-scale production whereas automation leads to larger-scale production and shorter cycle times. Finally, the commercial practices are not at all the same.

25046
CSO: 3698/A273

BRIEFS

ES2 EXPANDING--Edinburgh (CWN)-- European Silicon Structures, a semicustom chip manufacturer better known as ES2, has taken over Lattice Logic. This Scottish software company specializes in technical software. Approximately 1 million pounds are involved in the takeover. ES2 started in September 1985 and has had exclusive distribution rights in Europe for one of Lattice's three Chipsmith silicon compilers since November 1985. This optimized-array compiler, which ES2 put on the market under the name Solo 1000, offers chip developers extensive design efficiency. Solo 1000 runs on SUN, Apollo, and DEC workstations. There is also a PC/AT version. Lattice accepted the offer after an unsuccessful attempt last year to attract foreign capital. The 6-year-old Lattice lost 150,000 pounds last year. ES2 is one of Europe's latest high-tech companies. Several enterprises--Bull, Olivetti, and Philips among others--have invested a total of $60 million in ES2. Next year ES2 will break even with a $25-million turnover. ES2 wants to provide for the increasing demand in Europe for custom chips, technical software, and training and expects a turnover exceeding $100 million in 1990. [Text] [Amsterdam COMPUTERWORLD in Dutch 19 May 87 p 20] 25039

CSO: 3698/A255

EC RESEARCH BUDGET IMPASSE BREAKS, UK COMPROMISES

36980591 Paris LE MONDE in French 17 Jul 87 p 20

[Article by Philippe Lemaitre: "Way Cleared for European Framework Program for Research"]

[Text] Ending several months of stalemate, Great Britain finally has given the green light to adoption of the Community's framework program for research for the period 1987-1991. With this necessary step behind it, the Commission may now submit to member governments proposals for the continuation and, in some cases, the expansion, of current programs such as Esprit (information technology) and Race (telecommunications).

Due to lack of appropriations and especially prospects, these European research programs, whose implementation to date has generally been deemed quite fruitful, were in danger of withering.

Nevertheless, the British were strained in their endorsement, haggling over the figures to the very end and reserving the right to refuse to commit a portion of the funds allocated.

It was the Single European Act, adopted in December 1985 by the heads of state and of government of the Twelve, that emphasized the need to heighten common efforts in technological cooperation and research, complementing the establishment of one large market without borders. Procedurally, the Act called for unanimous adoption of a multiyear framework program, with the understanding that the individual programs that would follow could be adopted by a qualified majority. Discussion of the framework program degenerated into a budget dispute, at the end of which 11 countries had agreed to a compromise offered by Belgium, which chaired the deliberations . Only Great Britain refused.

The compromise involved a budget figure of 6.5 billion European Currency Units (ECUs) (Fr45 billion), composed of three distinct parts: 1.084 billion ECUs (Fr7.5 billion) from funds already appropriated but not yet spent; 863 million ECUs (Fr6 billion) from the "tail-end of the program," i.e., funds to be allocated after 1991; and 4.617 billion ECUs (Fr32 billion) in new money constituting the centerpiece of the new framework program.

A strange patchwork! It was this central core of 4.617 billion ECUs that continued to be attacked by Mrs Thatcher, the stubborn guardian of budgetary discipline, which she hoped would become the cardinal rule of EEC financing. She wanted the amount to be reduced by 417 million ECUs (Fr2.9 billion). The compromise she accepted, awkward as it was, ended the impasse.

Esprit Remains the Star

It was only in this way that individual programs such as Esprit 2 and Race could be adopted. The disputed 471 million ECUs are indeed included in the amounts covered by the political agreement, although they remain impounded, or in reserve. The English idea is that they can be released, when it will more clearly seen how budgetary discipline will be practiced in the future.

With respect to Race, the purpose of which is to prepare, on a European scale, the telecommunications network of the turn of the century (a wide-band network), the "definitional phase" was completed at the end of 1986. The Commission's proposals for the final phase were presented several months ago. It should be possible to launch the new program in October or November. The budgetary guerrilla war just witnessed, forced the Commission to lower the appropriation for this important project from 800 million ECUs (Fr5.6 billion) to 550 million ECUs (Fr3.8 billion).

The proposals concerning Esprit 2 could be submitted to member governments before the summer recesses. The financial commitment should be doubled: 1.6 billion ECUs over five years (Fr11 billion), instead of 750 million ECUs (Fr5.2 billion) for Esprit 1. It should also be remembered that the participating firms are making a financial commitment equal to that of the Community. The overall budget of the Esprit 2 project is therefore 3.2 billion ECUs (Fr22 billion).

The start-up of the framework program for research coincides with the second anniversary of the Eureka program, which was launched at the Paris ministerial conference and in which 19 West European nations are involved. Eureka, the purpose of which is to improve the competitiveness of European industry through cooperation between the firms of the Old World, appears to be in good health. Officially, 108 projects have been initiated.

About 40 new projects should be announced at the next ministerial conference, which will be held in Madrid in September. Eureka's flexible organization continues to attract manufacturers, while the concomitant absence of clear rules and therefore of certainty with respect to government financing commitments does not appear to be discouraging anyone. France, which originated Eureka, is participating in 60 projects; the United Kingdom in 41; and the Federal Republic of Germany in 29. States not belonging to the Community continue to play ball, too, with Switzerland involved in 16 projects and Sweden in 20. Once ratified by the political authorities, the projects do not remain under wraps. It is reported that the vast majority of the projects announced over the past two years have been begun. Many are at the preindustrial stage.

13221

EC ESPRIT II INITIATIVE TO PROMOTE BASIC RESEARCH

Brussels EEC PRESS RELEASE in English No IP (87) 248, 23 Jun 87 pp 1-2

[Text] In the second phase of the ESPRIT programme, the EEC Commission proposes to spend 50 million ECU on basic research projects designed to create a hard core of European research in this threatened sector and to provide a potential "reservoir" of basic research workers for the future comparable with that in the United States and Japan.

Basic research is the indispensable phase preceding precompetitive research, and in the Community countries, the basic research teams are for the most part only one-fifth the size of those in American and Japanese universities. Moreover, basic research at American universities has had the benefit of gifts averaging 300 million dollars annually from computer manufacturers alone.

In contrast, at national level in Europe, the reservoir of science graduates is running dangerously low owing to the attraction of precompetitive research, which, to the detriment of basic research, enjoys ever increasing financial support from the public and private sectors.

This shift of emphasis poses a twofold threat, because European sciences graduates and post-graduates are either
- leaving their laboratories prematurely for a career in industry, or
- moving to the United States in search of better living and working conditions.

This situation is potentially disastrous: although at present European universities are still world leaders in certain fields, sooner or later Europe will no longer have enough high-calibre university teachers to head the basic research teams. Faced with this situation and the resulting threats, the EEC Commission and eminent representatives of the world of science and industry--among whom are Professor Comeranuer from Marseille, inventor of the artificial intelligence language PROLOG, and Professor Von Klitzing, winner of the Nobel prize for physics in 1985--recently completed the preparation of a strategic-action plan that will form part of the second phase of the ESPRIT programme.

The aim is to devote some 50 million ECU in the next few years to the launching of European basic research projects to be carried out in collaboration between universities, industry and research centres. This

amount, which will be entered in the ESPRIT budget, will serve to cover part or even all of the expenditure on infrastructure and research fellowships.

The idea is simple: it is to create multi-disciplinary research teams with a "European" stamp in order to attain the indispensable size known to experts as "critical mass". This initiative comes at an opportune moment: European industry, aware of the dangers stemming from a decline of basic research in Europe, is ready to bear part of the cost of the operation.

The proposed action has a twofold objective, namely:
- to maintain a substantial basic research capability in various sectors likely to give rise in the future to technological breakthroughs in the vast field of information technology;
- to ensure cross-fertilization, i.e. the securing of mutual benefits through contacts between basic research and industrial applied research.

The sectors selected include:
- opto electronics and low-temperature electronics,
- learning of symbols, computer representation of acquired knowledge, problem solving,
- natural language process, translation, questions/answers,
- computer vision, speech analysis and synthesis,
- robotics, coordination of perception and movement,
- man/machine interaction.

CSO: 3698/A293

FRG'S RIESENHUBER PRESENTS DM 7.6 BILLION 1988 R&D BUDGET

Duesseldorf HANDELSBLATT in German 3 Aug 87 p 3

[Article by olb: "Research: Bonn Intends to Appropriate DM 7.6 Billion -- SPD: Budget Is Built on Sand; Riesenhuber: Mid-sized Companies Receive More Support than the Big Companies"]

[Text] "The FRG must become even more attractive as a research country in order to remain attractive as a [business] partner in the world and as a location for the industries of the future," so stated Federal Research Minister Heinz Riesenhuber as he presented the 1988 research budget, which has been approved by the federal cabinet and has been set at to DM 7.6 billion, an increase of 5% over 1987.

Riesenhuber appeared satisfied with the reorientation of research policy since 1982 and called it entirely successful. In this manner, independent initiative in research has been strengthened on a broad front, and a beginning has been made with urgent tasks involving the environment and critical resources.

Furthermore, lasting support has been given to basic research in a program that no longer discriminates against smaller and medium sized companies, providing specific measures to promote technological progress. Of the 15,000 companies conducting research in the FRG, subsidies to smaller and medium-sized companies have been twice as high as to large companies. According to statements made by the CDU minister, mid-sized companies received 16 cents from his budget for every mark they spend on research, but the large companies only receive eight.

Based on the budget report, research and development in the FRG is not primarily financed by the state. According to Riesenhuber, DM 59 billion will have presumably been doled out in this area during 1987. Of this, DM 7.3 came from his budget: "With this program, the federal government is sending out a signal: the government should not dominate research." We have market-oriented technological support to thank for this trend. However, on the other hand, the state must assume the tasks assigned to it in appropriate measure.

With respect to details, one can assume from the report that basic research is again to be expanded. Thus, for instance, according to an agreement with the federal states, basic financing for the Max Planck Society (not counting

special financing and project funds) will be increased by DM 21.1 million (5%) in 1988. The intension is to support research capability to explore new areas of basic knowledge and in particular to pick up new areas of study.

Also in the area of new key technologies, the scientific base is to be more strongly supported, while technical research, and, according to Riesenhuber, "development are a matter for the industrial, commercial sphere." Increased support for basic research has also been provided in computer technology, where the FRG still remains considerably behind the world market in some areas.

In the view of the SPD opposition, the research budget is "built on sand." According to Josef Vosen, SPD speaker for research policy, Riesenhuber's statements on the main points of the budget are meaningless because financing for the three large space projects, Ariane, Columbus, and Hermes, have not yet been clarified.

13127
CSO: 36980611

BMFT REPORTS MORE PRIVATE SECTOR INITIATIVE IN R&D FUNDING

Duesseldorf HANDELSBLATT in German 13 July 87 p 4

/Article by "na": "The Dynamic Increase in Research Funding Reflects the Private Sector's Strong Initiative"/

/Text/ Duesseldorf, 11/12 July 1987. A report of the Federal Ministry for Research concerning state research funding for the Federal Republic's private sector shows that compared with the state the private sector has greatly intensified its research efforts.

According to the latest Battelle estimate, research and development (R&D) expenditures in the FRG will total DM 59 billion in 1987, i.e. a 5-percent increase over 1986. With allowance made for the expected rate of inflation in the research field, this represents a real increase of 2.5 percent. Considering the GNP, research expenditures account for 2.9 percent. With an expected contribution of DM 36 billion, the private sector will cover 61.6 percent of Germany's total research expenditures. Since 1982, this share has been increased by nearly 6 percentage points. Correspondingly, the share of state research funding declined to 36.9 percent. All in all, R&D funding in 1987 increased by approximately DM 12.7 billion, as compared with 1982.

Seventy percent of all research funds are spent in the private sector. It is exptected that in 1987 the private sector will independently finance 83.6 percent of its research projects, while only 15 percent will be subsidized by the state. The Ministry for Research concludes from this that the private sector's dynamic research funding reflects a--politically desired--surge in independent initiative.

Increasing Competitiveness

Comparison of international figures shows that research growth could be even more dynamic. Compared with Japan, research funding in the FRG shows a smaller rate of growth. The Federal Ministry for Research and Technology warns that Germany's research effort must not weaken; it will be necessary to intensify research activities to improve competitiveness. The ministry points out that in Germany exports account for approximately one-third of the GNP, whereas in Japan and in the United States the export share amounts to no more than 17.5 and 9 percent, respectively.

The state's reserve in regard to financing of research and development is shown by the fact that federal R&D funding increased only moderately: from DM 11.6 billion in 1984 to DM 13.7 billion in 1987 (plan). During the same period, federal R&D support for the private sector showed even smaller gains (from DM 5 billion to 5.7 billion). The research survey shows that the Federal Ministry for Research and Technology allocated ever fewer funds to the private sector, while the Federal Ministry of Economics and the Federal Ministry of Defense kept increasing their outlay. In 1987, the Ministry for Research and Technology will cut its subsidies to the private sector to DM 2.2 billion; this represents a reduction of DM 350 million, as compared to 1984. In contrast, the Ministry of Defense and the Ministry of Economics increased their support of private sector research and development during this period (by approximately DM 750 and 300 million, respectively).

The following figures illustrate the policy change initiated to reduce direct, project-related support:

During the period from 1982 to 1987 (target), Research Ministry support of private sector research was cut down considerably--by approximately 1 billion down to DM 2.2 billion. Of the DM 2.2 billion, approximately 1.4 billion are allotted to direct, project-related support of market-oriented technologies, and approximately DM 430 million, to indirect and indirect-specific research support; the remainder (approximately 370 million) is earmarked for preparatory research and long-term state programs. For the most part, the reduction of state funding of private sector research is attributable to the cuts in direct, project-related support of market-oriented technologies. During the period from 1982 to 1986, the funds allotted to these areas declined by approximately DM 1 billion; in 1987, they will be reduced by another DM 200 million to DM 1.4 billion.

At the same time, support of research cooperation between science and the private sector intensified.

Likewise, support of small and medium-size enterprises was expanded greatly. Between 1981 and 1987, Research Ministry funding increased from DM 253 million to DM 509 million in 1987 (target).

According to the report, the Research Ministry's objective is not to invest more money in support of private sector research, but to improve the basic conditions for the development of research and development and to stimulate independent initiative on the part of privately owned, medium-size enterprises.

Reduction of Indirect Support

As early as 25 May 1987 and also on 9 and 10/11 July 1987, the HANDELSBLATT reported on the plans to reduce indirect and indirect-specific support through systematic--and in part early--discontinuance of support programs. In connection with the tax reform financing, even the R&D investment allowance is jeopardized. Most of these support measures, however, originate not from the Federal Ministry for Research and Technology, but from the Federal Ministry of Economics. All in all, the support made available in 1987 to medium-size

enterprises by the research and economics ministries amounts to approximately DM 1 billion.

High Technology Competitive

According to the Federal Ministry for Research and Technology, the widespread suspicion that large enterprises are given greater support than small and medium-size firms is unfounded. The ministry points out that on average small and medium-size enterprises receive 16 pfennigs for every mark they themselves spend on research, i.e. about twice the amount of state support granted to large enterprises (8 pfennigs).

In regard to technological competitiveness, the Research Ministry report states that the prospects of German industry in the international markets are promising: Regarding technology-intensive products, the foreign trade balance can be considered favorable; plastics, synthetic goods, chemical products, products of the machine building and electrical engineering industries, optical instruments and precision-mechanical products are distinguished by above-average competitiveness in world trade. The report also notes good prospects for certain research-intensive products; it mentions a recent study by the Fraunhofer Institute, according to which Federal German high-tech products are quite competitive vis-a-vis U.S. and Japanese products.

8760
CSO: 3620/300

TECHNOLOGY ASSESSMENT, R&D EVALUATION PROGRAMS SPOTLIGHTED

Introduction

Paris R&D EVALUATION NEWSLETTER in English No 87.2, 1987 p 1

[Editorial by Robert Chabbal, scientific counselor at the Center for Long-Term Forecasting and Evaluation]

[Excerpt] Ever since scientists have existed , their work has been the subject of a quality judgment by their peers, which is nothing short of an evaluation of "all the research players". What is new, however, is the evaluation of the added value of "research facilitors" or superstructures (organizations, programmes) set up by governments or businessmen to provide the "players" with the necessary individual or collective means. Professional codes, criteria and methods for this new type of evaluation do exist, but have yet to be perfected. I am confident that this newsletter will contribute much to this effort.

Alvey Program Evaluation

Paris R&D EVALUATION NEWSLETTER in English No 87.2, 1987 p 2

[Article by Luke Georghiou, PREST, The University, Manchester M13 9PL, phone: (44.61) 273.64.64: "The Alvey Programme"]

[Text] The United Kingdom Alvey programme is a five-year programme for advanced information technology research. Sponsored by the DTI (Department of Trade and Industry), the Ministry of Defence and the SERC (Science and Engineering Research Council) together with industry, it has an overall budget of 350 million pounds.

Its objective is to double the level of IT research in the UK over five years and to meet a number of detailed technical goals in the areas of Intelligent Knowledge-Based Systems, Software Engineering, Very Large Scale Integration and Man-Machine Interface. The programme's key feature is collaboration; at project level between companies and between companies and universities and at management level between the sponsors. In view of the unprecedented nature of the scale of the Programme, the Alvey Directorate felt that it was important that it should be evaluated and that the evaluation should be in real-time so that its development might be influenced by the feedback available. This

evaluation is being carried out by two groups, the Programme of Policy Research in Engineering, Science and Technology (PREST) at the University of Manchester and the Science Policy Research Unit (SPRU) at the University of Sussex.

PREST is assessing the structure and organization of Alvey. Several reports have been produced, one of them dealing with the major problem of collaborative research, in other words, the procedure for intellectual property rights and exploitation. Currently, the subjects under investigation are the project monitoring system and research clubs. In terms of general methodology, a variety of approaches are used including structured interviews, telephone and postal questionnaires and analysis of documentation. A sample of twelve projects has been selected for detailed case-studies of the workings of collaboration and the transition to exploitation.

SPRU is concerned with the effectiveness of Alvey in the context of the UK economy. The research falls into two categories: to establish whether the programme can be judged to have been a suitable policy for the UK and the compilation and exploitation of databases covering technological input and output indicators and economic indicators in Alvey-related areas. A book, "Parallel convergence" (Footnote 1) ("Parallel Convergence," published by Frances Pinter, 25 Covent Garden London WC2E 9DF - Phone: (44.1) 240.92.33)) (E. Arnold and K. Guy, Pinter 1986) has derived from this work. SPRU and PREST work closely together and are combining to produce a mid-term review of Alvey to be completed in the autumn of 1987.

EC Evaluation Database

Paris R&D EVALUATION NEWSLETTER in English No 87.2, 1987 p 6

[Article: "CEC--Database on Evaluators and Evaluations"]

[Text] The Commission of the European Communities has begun work on the compilation of a database on the evaluation of research. It will be stored on a computer in the Commission's Evaluation Unit in Brussels. All the information will be of a public nature, and printouts will be available on request by interested persons from evaluation units in Member States. The database is organized into five sections:

1. Government evaluation units;
2 Organizations which conduct evaluations (government, academic, not-for-profit and commercial);
3. Individuals who have served on evaluation panels or committees that have produced published reports;
4. Reports, books and conference proceedings on research evaluation, listed by publisher;
5. Papers and articles on research evaluation, listed by author.

The purpose of the database is to help the Commission, when conducting evaluations, to select experts for its independent panels (some 50 people a year are needed), to choose consultants for a variety of special studies and

to learn about new developments in evaluation methodology from the available literature.

Experts have been retained by the Commission in each Member State to prepare the entries in respect to their own country and they all met in Brussels on March 13 to discuss progress and agree on definitions, etc.... If any reader or organization has not already been contacted and would like to be included in the database, please write to Mr Massimo, Commission of the European Communities, 200 rue de la Loi (SDM 2/79), B-1049 Brussels, and ask for the necessary data entry forms.

UK's Department of Trade

Paris R&D EVALUATION NEWSLETTER in English No 87.2, 1987 pp 7-8

[Article by Bryan Avery, Department of Trade and Industry, Room 345 Ashdown House, 123 Victoria Street, London SW1E 6RB; phone: (44.1) 212.59.98]

[Text] The Department of Trade and Industry has a wide programme of science and technology (S&T) support, covering applied research, product and process development, and technology transfer. The S&T support budget in 1986/87 totalled 370 million pounds. Systematic assessment of all forms of support is undertaken by means of ex-ante appraisal, monitoring and ex-post evaluation. All existing measures must have ROAME statements which set down the underlying economic rationale for Government assistance; an explicit statement of policy objectives and how these may be tested; criteria for appraising applicants; arrangements for monitoring; and an outline evaluation plan.

At the appraisal stage, scheme guidelines are applied to individual S&T projects to determine their contribution to policy objectives, to verify the viability of the applicant and the project, and to confirm that additionnality exists, i.e. only projects which are specifically enhanced by support may be approved. During the lifetime of projects, monitoring takes place to ensure the project stays on course in technical and commercial terms, and that opportunities for exploitation are in the forefront. Post completion monitoring arrangements, which have recently been strengthened, provide systematic data on outcomes and future prospects for several years after the R&D phase is completed. This information forms one input to interim interviews and full ex-post evaluations. These are carried out by independent DTI assessment units, staffed by a mixture of technologists, economists and administrators. Their work may be supplemented by external consultants.

Different evaluation methodologies have been devised to suit various types of support and to reflect particular underlying policy objectives. More quantitative techniques, including ranking indicators, are appropriate for assessing development support. In such cases, outcome data in terms of achieved cost savings, or sales and profits, may be obtained through detailed survey investigation. In contrast, the extended timescales normally associated with research mean that assessments in this area focus more on technical achievements, dissemination of results, intellectual property rights and exploitation by licensing. Similar techniques apply to support for collaborative research, though an additional factor here is the impact of

support on future collaborations. DTI has a number of programmes to promote the commercial application of S&T results, including technical advisory services and technology awareness schemes. Specific evaluation techniques have been devised to assess the net impact of these forms of support.

In the future, certain non-confidential reports will be made more widely available through a new DTI assessment papers series. The first such studies will be published later this year.

EC's STOA Project

Paris R&D EVALUATION NEWSLETTER in English No 87.2, 1987 p 9

[Article by M. Holdsworth, European Parliament, Plateau de Kirchberg, Batiment Schumann, STOA project, Luxembourg L-2929; phone: (352) 430 01 ext 2511: "STOA Project at the European Parliament"]

The STOA project was launched at a meeting of the European Parliament's Committee on Energy, Research and Technology (CERT) in Brussels on Thursday, March 26 1987. STOA has been started for the same reasons that have impelled other parliaments to set up (as in the US and France) or to consider setting up (as in Germany and Britain) units for providing them with independent information and advice. The European Parliament increasingly finds itself dealing with matters which involve scientific or technological aspects. STOA will start life as an experimental project for a trial of 18 months.

Three initial major topics for investigation by STOA have been announced. They are: Effect of deregulation of telecommunications, Trans-frontier chemical pollution and Fusion research. A technology assessment documentation centre will also be set up at the EP Library in Luxembourg. It should be noted that STOA's role in such investigations will not be to define the position of the European Parliament, since this is the political responsibility of Parliament as such. The job of a unit like STOA is to clarify the policy options and the arguments for and against each option. STOA will also publish a monthly newsletter. Persons interested can write to the European Parliament.

CSO: 3698/A282-E

HUNGARY TRYING TO PENETRATE BENELUX COMPUTER MARKET

Amsterdam COMPUTERWORLD in Dutch 26 May 87 p 19

[Article: "An East European Company at Europe Software: Hungarian Company Shows Off Cheap Personnel"; first paragraph is COMPUTERWORLD introduction]

[Text] Utrecht--Szamalk Computing Applications and Service, the only East European participant at Europe Software, stood somewhat tucked away behind the larger stands. It had an IBM PC/AT on display accompanied by several friendly Hungarians.

Szamalk is active on two fronts: It has several products in its portfolio and sends Hungarian personnel on assignment to Western companies. At the fair this Hungarian company presented Genesys, an expert system shell. The product's name is not a very clever choice for the Benelux market given the reopening of a company of the same name in Alkmaar. The company also produces an IBM-3780 emulation program.

Gabor Halasz, export manager of Hungary's largest software house, explains their presence at the fair. "We export quite a lot to German speaking countries. We are now in Utrecht to show our willingness to start operating in the Benelux as well." The Hungarians maintain contacts with the Netherlands company PC-Choice.

Szamalk is located in Budapest and has 1,300 employees, including 500 programmers. The company's turnover amounts to 585 million forints (the official equivalent is 30 million guilders). Szamalk's Hungarian programmers are free to work abroad--unlike, for example, Hungarian soccer players who have to play in their own country until they are 28 years old.

Szamalk has assigned personnel to BMW, Siemens, and others. Halasz: "Our staff is cheaper than yours. Hungarian programmers usually have a university degree and are willing to work hard."

An obvious question is whether it is not difficult to do business between East and West. "If both parties want to do business, there is no problem. Mind you, I am not saying it is as easy as between Western countries, but as long as there is goodwill, difficulties can be overcome."

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DEVELOPMENT OF MICROELECTRONICS IN GDR

35190102 Paris DEFENSE NATIONALE in French Mar 87 pp 133-142

[Article by Eric Daniel: "Microelectronics in the German Democratic Republic"; first paragraph is DEFENSE NATIONALE introduction]

[Text] Although we are well informed of Western technological capabilities, our knowledge of Eastern-bloc performance in high technology, as in many other fields, is far from precise. Mr Eric Daniel has completed a study of microelectronics in the GDR, which he summarizes in the following article. It will be noted the large extent to which the regime's methods can only lead to frequently mediocre results.

Since 1980, the German Democratic Republic has concentrated all its efforts on high growth, export industries. Structural industrial policy has earmarked most of its funds for exploiting all the possibilities of modern technology and developing the high tech sectors, usually at the expense of whole sectors of its traditional industrial technologies.

Although initially handicapped by an unequally developed industry and the lack of raw materials and energy resources, well before it became a socialist state, the GDR had an industrial infrastructure that has allowed it to get ahead of its Soviet-bloc partners by relying on the know-how of its secondary industry.

Thus, the GDR's industrial level makes it a valuable partner for the USSR. On the one hand, it is poor in natural resources and buys most of the raw materials and energy sources it imports from the Soviet Union. On the other, it is the Soviet Union's leading supplier of manufactured products and capital goods. (It should be noted, however, that East German exports account for only 11 percent of Soviet imports, while Soviet-East German trade represents 30 to 40 percent of GDR trade.) Moreover, foreign trade represents 25 percent of GDR GNP, as compared to only 5 to 6 percent of the USSR's. Clearly, exports are the key sector in the East German economy.

Since the GDR obviously cannot survive without foreign trade to pay for its purchases of staple commodities, and since it must make up for its trade deficit with its partner, we can suppose that it is, and will for some years continue to be, forced to produce goods that it can export within the

context of its commitments to the USSR, and even to CEMA as a whole. Notwithstanding, the GDR has advantages that place it in a choice position vis-a-vis the USSR.

In effect, East Germany is seen as the geographical link between the Eastern and Western blocs. It therefore has a dual role--both political and economic--within the Soviet world. On the one hand, it represents the forward bastion of socialism in Western Europe, serving as both a showcase and an ideological rampart. On the other hand, on the economic level, it is able to acquire, and thus to distribute, Western technology among its partners. This makes the GDR a very important country within the Eastern bloc, since given its peculiar position, it should decrease the socialist countries' technological dependency. Thus, within CEMA, it is the second supplier of finished goods after the USSR.

In 1984, the GDR was twelfth in the industrialized world and sixth in Europe. Most important, within CEMA, it is second only to the USSR in industrial production. Consequently, it can now be considered a full-fledged industrial power.

We are witnessing an important shift in the industrial policy of this country, which had hitherto sought to strengthen its economy by developing its various sectors in a balanced fashion. The change in GDR industrial policy in recent years is not motivated exclusively by economic reasons, but also by political ones, in the context of the "international socialist division of labor," which assigns each country a mission. This specialization hinders the diversified development of its industry. Thus, because of its experience in the industrial sector and out of necessity, since it had no other primary resource, the GDR was chosen as the Soviet-bloc country to develop microelectronics. Its industrial policy has attached great importance to this sector, especially under the most recent 5-Year Plan, in which microelectronics are given a predominant place and are considered to be "the main tool for industrial production growth."

Production volume in the electronics sector is to grow by 56 to 58 percent in the 1980's. Within this sector, microelectronics is to play an ever increasing role. The goals adopted for the 1980-1985 plan at the eighth SED (German Socialist Unity Party) congress dealt with export capacity, increasing the productivity of domestic industry, cutting energy and natural resource consumption, rationalizing labor and reducing working hours, and increasing manufacturing output.

GDR Technological Level

Although the lack of specific information makes it difficult to evaluate the GDR's technological level, a careful look at a sample of chips on the market shows a definite lag in comparison with the West. In 1983, through its microelectronics combine, the GDR was selling 16-kilobit dynamic random-access memory (DRAM) IC's and 8-bit microprocessors. Moreover, it seems

that the 64-kilobit DRAM lines have just become available recently, at least for industrial purposes. A 16-bit microprocessor was to have been unveiled at the last Leipzig fair in 1985. It was still awaited in 1986.

This technological level, which can be considered a fait accompli in the West since 1980, belies the trouble East Germany and, generally speaking, the Soviet bloc as a whole are having in closing the gap. Although some reports place the GDR 10 years behind Japan and 7 years behind the United States, in the area of mass production, we can agree on a lag of 5 years, a figure that appears not to have moved one way or the other since the beginning of this industry.

In addition, the GDR seems to have limited itself to certain technologies that are among those which the West has best mastered and have been mass-produced for a relatively long time. One might wonder whether this limitation accurately reflects the competency of East German engineers and researchers. It would appear unlikely, given the country's background.

In addition to its undeniable industrial calling, East Germany has one of the world's best educational systems. The paradoxical results of economic and political options has turned out to be the existence of a labor pool that is overqualified in relation to the worn-out industrial plant. While only 10 to 15 percent of the young enter the labor force without vocational or professional training, 33 percent of the jobs require none. Another significant example of this situation is that the GDR has 0.6 technicians for every researcher or engineer, while the international average is 6. Within companies, this phenomenon is expressed by the underemployment of engineers; 25 percent of East German scientists consider themselves underemployed. This feeling seems to be the cause of a certain lack of motivation within the scientific community. The GDR suffers from the contradiction between the government's efforts to improve worker vocational and professional training and the needs of a technologically underdeveloped economy. The fact is that the GDR has considerable scientific potential but does not appear to be able to put all the hoped-for-advantages to work for the economy.

The GDR has great difficulty in transferring its technology to the production line, where it is also faced with problems of worker carelessness. Voluntary or involuntary negligence is common in the clean room or on the production line, which does not contribute to improving output already lowered by an aging and generally obsolete plant. This very low output, together with limited production-unit capacities, explain East Germany's difficulties in meeting its needs and mastering certain industrial processes, despite its frequently being able to take a technology as far as the prototype.

Moreover, in light of the very close understanding between Mr Honecker's government and Moscow, one can imagine the extent of the USSR's influence over East German initiatives, and political and economic ties between the countries are obviously very strong. The GDR's economic dependency on the USSR means that it is forced to deliver a large part of its production to

the Soviets. Of the 15 million integrated circuits produced at the Erfurt microelectronics combine in 1983, 70 percent were delivered to the USSR and only 20 percent were used domestically.

This implies, in part, that the GDR must adapt itself to Soviet conventions and standards. It also means that it is obliged to place Soviet needs before its own. However, the inverse apparently is not true, as it is difficult to procure a Soviet chip in the GDR; they are placed on confidential lists and can only be sold outside the USSR with Soviet approval. In all events, Soviet-supplied chips are of mediocre quality and are sometimes even unusable. Moreover, this situation is not limited to chips. Thus, the USSR practices with its partners what might be called "unilateral cooperation," since, while generally unable to supply equipment and raw materials of a quality and at prices similar to those that the GDR can get from its Western suppliers, it copies East German technology under the cover of numerous agreements.

Another reason for the lack of competitiveness is, without a doubt, the ever-increasing control of the central government, as can be demonstrated by the recent creation of combines. Following the socialist takeover of East Germany, all trusts and large private companies were turned into "State Enterprises" (SAG). Beginning in 1953, they were renamed "Nationally-Owned Businesses" and VVB's (bodies linking the central government and production units). Until 1970, the other production units remained private or semi-public, under contract to the public sector. By 1972, the private sector had completely disappeared, with "public" production totaling 99.9 percent. Only commerce and handicraft remained in private hands. Moreover, the 1970's were marked by industrial restructuring, and in particular by important changes in economic planning and management in the direction of greater centralization. This industrial restructuring was completed in 1981 with the merger of all state-run companies into combines. Combines are the vertical and horizontal integration of businesses in a single sector dependent either on a VVB or directly under a supervisory industrial ministry. Working under tighter central government control, their purpose is to make their sector profitable by various means, i.e., the cutting of production costs by combining departments common to the merged companies, the reduction of investments made possible by large scale production, and the more rapid implementation of technological advances as a result of the concentration of means within the combine.

This step is one of a series of measures aimed at increased centralization. The presence of "party" representatives at all levels of East German business gives economic criteria an importance that usually outweighs technological possibilities. There is no doubt that an industry such as microelectronics requires skilled labor and, more importantly, a minimum degree of professional conscience. Yet this sector appears to suffer from a lack of motivation brought on by a combination of over-qualified workers and greater government control.

Production of Equipment

The Karl Zeiss Jena combine is the biggest supplier to the microelectronics industry in the GDR. It furnishes all measurement instruments and all electronic or optical lithography and testing equipment, in particular an electron-beam direct etching machine. It is undoubtably the most open company and the first to become established on the international market. It has, for example, equipped most of the world's planetariums. It also participates in international trade fairs and seems to be the only world-class East German company. Moreover, it is considered by the Soviets to be for this reason a "model" CEMA business.

It is important to emphasize that the Karl Zeiss Jena combine provides the GDR with equipment that, while unable to compete with Western products due to the weakness of the East German electronics and robotics industry, does include features that place it on an international level. A solution remains to be found to the problems of capacity and manufacturing output, the latter being estimated at one-tenth that of the Western equivalents of these machines. However, the Karl Zeiss Jena company contributes greatly to the GDR's standing within CEMA.

The other equipment necessary for integrated circuit fabrication appears only to be manufactured in small quantities in the ZFTM units and usually remains at the developmental stage. In reality, one of these units' roles is, to a large extent, that of modifying equipment purchased in the USSR, specifically diffusion ovens and epitaxy reactors, and making it "usable." The GDR seems to have had numerous problems with the high vacuum installations necessary for most microelectronics. The fact is that the Soviet-built machines are poor, usually non-operational copies of machines purchased in the West, and they have to be reworked before they can be installed in the factory. It also appears that no other Soviet-bloc countries are developing this kind of equipment.

Silicon wafer machining equipment still has very limited capabilities. It is usually antiquated and can only process small wafers--mostly Soviet-standard sizes. There is no doubt that in order to be able to produce bigger wafers, the GDR will have to buy its equipment in the West. "Clean room" technology is also a weak point for the East Germans, who still suffer from poor contamination control, which is one of the reasons for their low fabrication yields.

Obviously, this situation and this technology gap are difficult for the GDR to overcome. Moreover, the foreign exchange shortage slows the acquisition of machinery from the West.

East-West Microelectronics Trade

Western nations theoretically exercise strict control over the sale of high technology and sophisticated equipment to East-bloc countries under the

restrictions set by COCOM (Strategic Materials Export Control Coordinating Committee). This is particularly true in the area of equipment or products for microelectronics. However, the GDR is partially able to circumvent this embargo. Indeed, one can see a lot of equipment and products of Western origin in the GDR, and, although their exact characteristics are not known, it would appear that they often exceed the limits set by the control lists. Even more commonly, whether or not the equipment involved is sensitive, Soviet-supplied items have been abandoned in favor of Western ones.

The Federal Republic of Germany plays a predominant role. Whether in the supply of raw materials, sophisticated measurement instruments, or computer systems, the FRG provides its German neighbor zero-interest loans, non-foreign-exchange payments, duty-free trade, and various subsidies. Moreover, replacement parts to be used to modernize or repair Soviet machines represent 60 percent of all capital goods imported from the FRG, a figure which helps to explain the East German need to turn to the West. There is also considerable trade with certain West German firms, as well as with certain West German subsidiaries of European countries which often play the role of middleman. One example is the purchase of silicon from a British company through its German subsidiary. In this way, the GDR is able partially to sidestep COCOM restrictions, as well as those imposed by the Soviet Union, which are far from giving the GDR special financial advantages in such purchases of equipment and materials.

Other OECD countries also supply similar items. Among them are Austria and Sweden, the main partners to have signed cooperative agreements with the GDR. Thus, the Dresden center (VDB ZFTM) boasts a "pilot" assembly line, equipped entirely with Western machines and installed by an Austrian company. Denmark, Sweden, and Japan supply 4-inch silicon wafers and the associated fabrication equipment (unavailable within CEMA), as well as the ultra-pure materials required by certain equipment and for integrated circuit fabrication (pure metals, quartz, graphite, masking resins, etc.).

Conclusion

Three observations summarize the state of microelectronics in the GDR.

When it comes to technological know-how, the GDR leads the CEMA nations, essentially because of Karl-Zeiss-Jena manufactured equipment, which is almost up to a level where it could be used in the West. The most noteworthy instance is that of an electron-beam lithography machine.

Notwithstanding, production levels are still far below those of the Soviet Union. Manufacturing quality and output remain quite poor as a result of the many subsisting plant difficiencies, as well as, perhaps, a technological choice placing greater importance in economic and political criteria than in scientific and technological considerations.

The GDR's privileged relationship with the West, and especially with the FRG, gives it access to equipment and materials of Western origin, sometimes inspite of COCOM restrictions.

On the economic and political level, it remains highly dependent on the Soviet Union, which imposes its technological orientations while profiting greatly from GDR capabilities by massively importing its integrated circuits and, above all, its etching equipment, as well as by copying them.

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INVESTMENT, R&D IN NEW MATERIALS

São Paulo ISTOE in Portuguese 12 Aug 87 pp 40-46

[Article by Ottoni Fernandes Jr. "A Sea Change", first paragraph is subhead]

[Text] A materials revolution is under way and Brazil needs to keep up with it.

For half a century Brazil has been nurturing a dream of greatness. Our mineral wealth was supposed to be the foundation for huge national industries based on exporting conventional ores and metals that the developed countries did not have. But now the rapid pace of the technological revolution in the developed countries is threatening this vision. A new generation of materials is coming to the fore. ceramics, plastics and unusual alloys which are increasingly superseding and outperforming conventional raw materials. The space race and the energy crisis of the seventies have altered the pattern of consumption in the First World as an effort was made to reduce dependence on foreign raw materials. Thus the market soon saw materials designed to order, made with highly advanced resources such as subatomic physics and computers, and these materials are displacing traditional metals of long standing like iron, nickel, tin, zinc and manganese.

In Japan, advanced ceramics are already being employed to make scissors, cutlery, piston rings and turbocompressors. One of the secrets of the Honda motor in the Williams aircraft flown by Nelson Piquet and Nigel Mansell is the application of special ceramics in the turbocompressor, which substantially steps up the power. The world market for these high-tech ceramics is $5.8 billion and is predicted to grow by 20 percent annually through 1990.

In aeronautics, the use of special compounds is growing, such as carbon fiber (see the range of new materials described in the box on p. 42), which resist very high temperatures but are much lighter than conventional materials. About 5 percent of the weight of the Boeing 707, for example, is advanced compounds and plastics whose world market is estimated at $1.5 billion. Special plastics that are light and easy to install are now widely used in new cars and are helping to reduce the average weight of the American car from 1.7 metric tons in 1975 to 1.5 metric tons in 1985. The percentage of iron and steel in automobiles has fallen from 81 percent to 69

percent, while the percentage of plastic has risen from 6 percent to 11 percent.

There is no doubt but what the sky is the limit as far as these new materials are concerned, because technological advances and growing demand are lowering prices in comparison with conventional metals. The Japanese Ministry of Technology and Foreign Trade calculates that this promising new market will be $266 billion by the end of the century, a tenfold increase over today's market. The other side of the coin is weaker demand and concomitant lower prices for conventional raw materials, which will hurt exporters that do not plan for this international economic eventuality.

The signs are already evident in the market for ores and metals, as can be seen in Brazilian export figures. the decline in export tonnage from 1984 to 1986 was 65 percent for zinc, 37 percent for bauxite and 20 percent for manganese. The market for iron has not yet been affected. iron ore exports increased 4.8 percent in these 2 years. But the outlook for the future could be bleak. And huge projects are under way, such as the Carajás Complex (mine, railroad and port facilities) which is designed to produce up to 35 million metric tons of iron ore annually for foreign blast furnaces. Last year alone, the complex loaded 14 million metric tons into the holds of ships. In addition, Mineração Rio do Norte, a Vale venture including private groups, located in Porto Trombetas in Pará, can produce 4 million metric tons of bauxite annually.

It is understandable, then, that Brazilian technicians in the mineral sector are openly concerned about the new outlook for raw materials on the world market. "Miniaturization, the production of smaller and smaller products, in combination with the growing utilization of scrap iron and the development of new materials is adversely affecting the use of metals and conventional materials," says José Belfort dos Santos, general manager of the National Mineral Production Department (DNPM), with the authority of the official who heads the agency in charge of making and implementing Brazilian mining policy. In the light of lower prices and a weakened market for the common mineral ores, Santos believes that it is crucial for Brazil to develop technology for using these minerals now that it has achieved high mineral production efficiency. This implies lower sales of unprocessed ores and a trend toward further processing prior to exporting ores.

In Santos' opinion, Brazil must make a complete survey of its mineral resources, with emphasis on exploration for and processing of minerals that still have a good world market. This is what is promised by Raimundo Mascarenhas, president of the government-owned Companhia Vale do Rio Doce (CRVD), Brazil's most efficient mining and exporting company. "In spite of their decline in relative terms, products like aluminum and iron ore will still be used for many applications in the future, although competition will sharpen." He says that Vale is ready for the fray "because we are using high technology and have low production costs."

Aware of the new trends, Vale is beginning to diversify its capital, with an eye on such markets as titanium. Deoclésio Rodrigues, director of development, points out that the state-owned CVRD has been preparing for the challenges of the post-industrial era since 1984. The company even reorganized its research function, creating a Technology Oversight Division consisting of a laboratory complex in Belo Horizonte emplyoing 260 persons, half of whom are degreed. Plans call for spending $70 million in research and development over the next 5 years, half on the company's conventional products and half on new materials research.

The goal of new materials research is titanium compounds based on anatase or octahedrite. Brazil has 1.5 billion metric tons of this mineral, which is 20 percent titanium oxide. A pilot plant capable of enriching the ore up to 90 percent titanium oxide is already in existence in Tapira in the state of Minas Gerais. In addition, there is a basic plan for a plant designed to produce 200,000 metric tons of the product annually, also to be located in Tapira, and it is scheduled to begin production in 1990 after a $140 million investment. The plant will eliminate the need to import titanium acid for the ink and dye industry.

Vale is also betting on metallic titanium, one of the products most in demand in the 1980s and 1990s. Research is being carried out jointly with the Aeronautical Technology Center (CTA) in São José dos Campos. Engineer Carlos Schmidt Rover of CTA's Materials Division is involved in this project, which has already produced a spongy sort of titanium in a pilot plant. "Brazil needs metallic titanium. It has the mechanical strength of steel, but is 60 percent lighter," says Rover. Another of its properties is that it is less susceptible to corrosion than stainless steel. One of the main uses of titanium is for the external doors of ships, submarines and aircraft. The drawback is its price, which is twice that of steel.

Vale is supported by the government. Renato Archer, minister of science and technology, believes the company is right to face the challenge of competition in the area of new materials. Archer thinks that there will be a gradual trend toward phasing out conventional materials rather than overnight obsolescence. "This means investment in the research and development of new materials as well as simultaneous investment to improve the quality of conventional materials." Since Brazil has large reserves of strategic raw materials such as titanium, quartz and rare earths used in ceramics, Archer believes that it is essential to invest in Brazilian exploration and industrialization projects.

The Ministry of Science and Technology is beginning to organize forces to meet these new technological challenges. Two new desks have been created. Fine Chemicals and New Materials. Prof Roberto Villas-Boas of the Federal University of Rio de Janeiro has been offered a position as head of the latter. In May of this year, the Biennial Scientific and Technological Development of New Materials Program was initiated. It has a budget of $20 million this year and $40 million in 1988 to train personnel, build labora-

tories, carry out research and quality control and start up new production units in this vital sector. This is no small amount of money by Brazilian standards, but it is relatively little in comparison with funds allocated in the First World. A single US company, Alcoa, spent $142 million for research and development last year, mostly on special alloys and compounds in an effort to make its own traditional product, metallic aluminum, obsolete.

The ministry's program is based on the premise that conventional raw materials now being used will be displaced and that exports of these raw materials by developing countries will decline. Thus, heavy horizontal facilities designed to ship and market huge tonnages of conventional ores will become obsolete.

By the end of the century, two different kinds of plants will have emerged. In the First World, the emphasis will be on the manufacture of new materials (special compounds and alloys, advanced plastics and ceramics) in small-scale plants using production processes incolving computers from the planning phase through final production. Highly automated plants will produce highly specialized products on a small scale. These plants will be capable of adapting to changing markets by modifying a few units in the production lines. A common factor in these products will be their high-tech component. It will fall to the developing countries to provide the raw materials, especially those that consume high amounts of energy.

In the opinion of Luíz Carlos Bresser Pereira, minister of the Treasury, this post-industrial technological revolution will lead to excess capacity in all the conventional mineral-exporting industries. What is happening in steel is already an example of this. "It is therefore very difficult to justify large investment in this sector in Brazil," says Pereira. "Priority should be given to high-tech capital intensive projects such as the aerospace, electronics and capital goods industries."

An ability to understand world market trends becomes more important as an ever greater number of companies compete for their share in the demanding marketplaces of the First World. This is the experience of Metal Leve, an automotive parts maker in São Paulo, which has long been exporting, especially to the United States. Engineer Víctor Gonçalves, the company's research and technology director, said that the company makes 10 alloys in different compositions based on aluminum, silicon and copper to meet customers' requirements. In some cases, magnesium or nickel is added. Now Metal Leve is looking into aluminum ceramics strong enough to be used as piston heads and resist expansion while reducing weight.

The project was begun two and a half years ago and required setting up a laboratory at a cost of $400,000. The laboratory was equipped with a scanning microscope to study the atomic structure of materials. Since it was desired to use ceramics containing iron or special alloys, the company also bought a special $1.5 million press capable of making ceramic implants on metal. A porous ceramic is used that is absorbed by the metal in the mold-

ing process. "These components should be on the market within 2 years," says Gonçalves enthusiastically.

Universities and foundations host other important new materials research centers. The Energy and Nuclear Research Institute (IPEN) in São Paulo is one of the most advanced centers for special ceramics. It already has a pilot plant in operation that can turn out a metric ton a month of zirconite (zirconium oxide) of sufficient purity for making specialized ceramics such as Zircaloy, which is used in nuclear reactors. But in spite of this accomplishment, engineer José Carlos Bressiane of IPEN's Ceramics Department, estimates that Brazil is at least 15 years behind the developed countries in this area. "In Brazil there are 143 persons working in this area, including technicians, engineers and scientists, which is fewer than what a single good American university might have," Bressiane laments.

But Cerâmicas Especializadas (Keramus) of São Paulo has plans to advance the production of more advanced compounds along the lines of those now being used in Japan to make pillow blocks, ball bearings and turbine blades. Keramus is now making shaped products for electrical or insulation applications and the pencil-making, chemical and petrochemical industries. Modifications of the process line will entail the purchase of an isostatic press and new roasting furnaces costing $1 million.

In the area of compound materials, one of the main research centers is the Aeronautical Technology Center (CTA), which is now building a pilot plant to produce carbon fiber that EMBRAER is now importing. This fiber is used in parts for its own aircraft and in the manufacture of wing parts for the MD-11, the successor of the DC-10, which McDonnell Douglas of the US has contracted out to EMBRAER. Of the 3,000 parts in the Brasília, EMBRAER's top-of-the-line aircraft, 300 are already being made of compound materials, i.e., 10 percent of the total. Physicist Choyu Otani of the CTA advises that when the technology is perfected, it will be offered for sale to the private sector.

Similar to the breakthrough in genetic engineering that paved the way for manufacturing medicines with special bacteria whose genetic codes have been altered, the new materials may be designed to have certain properties determined beforehand. Knowledge of the structure and forces existing in the crystals or molecules of a substance makes it possible to interpose thousands of atoms of a second material into the substance. Supercomputers can determine the interaction of thousands of particles fast and accurately. But there is a tremendous gap between the new possibilities that science has opened up and the hard reality prevailing at Brazilian research centers.

The Department of Materials Engineering (DEMA) of the Federal University of São Carlos (UFScar), for example, is unable to advance any farther in research because its electron microscope, bought in 1974 with credit provided by the Interamerican Development Bank, has technical problems and only operates at 30 percent of capacity. A pioneer in materials engineering courses

in Brazil, the UFScar Graduate School, beginning in 1970, trained an entire generation of technicians. Now the school is being held back because of a shortage of funding, a problem which it is trying to overcome by performing chemical analyses and tests for area companies, explains Prof Edgar Dutra Zanotto. Because of these problems, the institution no longer serves as a catalyst for the creation of new materials in the São Carlos area. Since 1978, 10 companies have been formed as spin-offs from university research.

One of these is Engenharia de Materiais Especiais (ENGEMASA), a small-scale metallurgy company producing parts made of special alloys to replace imported parts made of superalloys or low-carbon steel. Engineer Paulo Roberto Altomani, ENGEMASA's president and general manager, formerly of DEMA, says that the company spends 2.5 percent of its profits on research and is now starting to build a new vacuum furnace capable of attaining temperatures of 1,850 degrees centigrade to cast titanium parts. The company's laboratories have a computerized spectrometer that can determine the composition of a given alloy in 5 seconds. With these facilities, ENGEMASA has succeeded in producing Hastelloy, a superalloy of nickel, chromium and molybdenum that was made in the US in 1985.

Selling technology to private companies is a method that several research centers have turned to in order to finance projects. This has also been the case at the Department of Alloys and Metals at the Technological Research Institute (IPT) in São Paulo, which, as engineer Fernando Landgraf explains, has just developed miniaturized rare-earth magnets only 3 years after their discovery. The technology has been sold to Supergauss, which will try to apply it in its product lines, including hearing aids and small motors.

In spite of these promising arrangements, research and production of new materials in Brazil is still in the initial phases. In industry, only the automotive plants are using advanced plastics on a large scale. these plastics are now being used in bumpers on the Escort, Uno and the Voyage. The Brazilian auto industry began phasing in these plastics as it started making cars for the export market. "But we are always concerned about the sophisticated market of the Brazilian consumer," explains Ronaldo Delay, a parts engineer and executive at Autolatina (a joint venture between Ford and Volkswagen). In the process, the 1988 models will have a 65-liter injection-molded plastic fuel tank that is cheaper but not safer than the conventional design. One of the great advantages of the new materials is that they facilitate assembly on the production line, an operation that can account for 40 percent of the cost of a car.

However, Brazil has a long way to go to in new materials to catch up with the First World. The effort will require the government to define industrial development priorities carefully, with the knowledge that every advance will require huge outlays. And as policies are re-evaluated, large investments in areas with poor prospects in the post-industrial era, such as iron and steel, must be questioned. A planning error made in the entryway to the future may undo a great effort made by society and turn huge complexes into scrap metal.

[Boxed material beginning on p 42]

Improving Nature

The so-called new materials will change consumer patterns before the end of the millenium. Here are some examples of these changes.

Ceramics. In spite of the fact that ceramics are the most ancient materials known in the history of mankind after chipped rock, new technological processes are transforming ceramics into the most modern products. Their biggest advantage for the future is price. 95 percent of the earth's crust consists of silico-aluminum rocks and clays, the basic raw materials for ceramics. They are also much lighter than metals, in some cases up to 40 percent lighter. In the case of automobiles, reduced weight means savings in fuel. For every 100 kg of weight reduction, a car may save up to 1,000 liters of fuel during its service life. They are also harder than the best metals. But the greatest advantage of this new material is its excellent insulating properties. In the newest motors, which are still a long way from routine assembly-line production for Formula-1 races, ceramics make it possible to burn fuel at a much higher temperature, considerably exceeding that of the best metal alloys, which melt at 1,200 degrees Centigrade. This partly eliminates pollution and improves the car's performance.

Ceramics may even render today's Formula-1 motors obsolete by making it feasible to use turbines in cars. In turbines, the fuel is not compressed in cycles as it is in conventional piston motors. Turbines continuously burn any kind of fuel, from the lowest-quality fuels to the highest, without any design modifications. The result is a powerful, quiet, economic, nonpolluting motor. In spite of all these advantages, ceramics are still faced with a serious marketing obstacle. When they are mass produced, they are quite brittle and break very easily. This disadvantage is being overcome to some extent by additives.

Plastics. Nylon, the first engineered plastic, appeared in the early forties in the textile industry with the production of fiber for making lingerie. Unlike the delicate and fragile early plastics, today's plastics are heavy-duty products, replacing metal, glass and wood in a number of applications. Strong as some metals, resistant to temperatures as high as 300 degrees Centigrade and weighing one sixth as much as steel, plastics have gained an irreversible toehold in the automobile industry.

The trend is not only to replace metal, but also to perform completely new functions. An example is polymer membranes. These membranes are an extremely fine material that can filter out molecules by their size or energy level. These membranes will prevent the costly changes of phase that occur in many chemical reactions in a process similar to obtaining steam without boiling water, since only the most excited molecules pass through the membrane and can then be condensed. The membranes are also involved in an innovative process of producing chlorine and caustic soda that eliminates the use of mercury and amianthus, substances that are known to be toxic.

Compounds. Compounds are mixed substances with better properties than any single component. Designers can thus virtually create new materials on the drawing board with the flexibility and light weight of plastics combined with the property of metals to conduct electricity. Carbon fiber wrapped in an epoxy matrix like araldite glue are stronger than aluminum and much lighter. The Brazilian aeronautical industry has already incorporated this innovation. the leading edges of the wings of the Brasília made by EMBRAER are made of carbon fiber and only weigh 20 kg. They would weigh 45 kg if made of aluminum.

Metal alloys. In a genuine improvement of nature, scientists are switching around atoms in metal crystals to obtain materials with hitherto unknown properties, such as components with "memory" that return to their original shape after deformation. In special-alloy smelting processes, scientists force metal to behave like living things, growing fibers as strong as conventional crystalline structures. Alloying rare earths to magnetized iron materials, scientists are making magnets thousands of times more powerful than natural magnets, making it possible to manufacture high-powered micromotors. Even the conventional transformers seen everywhere on powerlines will change. Every year they waste almost 400 billion kilowatt-hours in parasite currents worldwide that flow uselessly in the core of the metal. Recently developed amorphous metals drastically reduce these currents and will allow a worldwide saving of about 100 billion kilowatt-hours, almost half Brazil's entire output of electricity.

New materials will also make processes cheaper. metal alloys may now make the conventional metalworking crucible obsolete. Powdered metals can be pressed almost into final form, eliminating losses in burrs and fins, and then cast. Finishing can then be done to a degree of precision never dreamed of before. laser beams instead of sandpaper can provide the final touch and polishing down to the last few layers of molecules.

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